AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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Band Saws for Metal Work.*

Circular saws for cutting hot and cold metal have been in use for many years, and band saws for cutting metal when cold are also gradually coming into general use.

As long ago as 1866, Panhard & Levassor, of Paris, made investigations which resulted in their exhibiting one at the Havre Maritime and Universal Exhibition in 1868. It was the middle of the seventies before it could be said that band saws had been introduced in French shops. In 1880, however, the Southern Company, in Bordeaux, began experiments which were continued for several years, and culminated in the publication of a paper† showing the advantages of band saws for metal work, and giving the costs of certain kinds of work.

In England, band saws for cutting off bars and plates were first used at the Woolwich Arsenal in 1866. They are still in use there for cutting out plate frames for gun carriages, nuts, wedges or wrought iron. They were, however, introduced, generally in England at a much later date.

B. & S. Massey, of Openshaw, near Manchester, state that they first built a saw for their own use in the eighties; this was used for cutting out plates with curved outlines used for hammer frames, and gave such great satisfaction that they were soon introduced in other works. These

Fig. 1 Fig. 2

are now frequently found in many works, such as shipyards, bridge and boiler works, etc.

Although conservatism has prevented the general introduction of metal band saws in German shops, there are no less than ten in use in Krupp's Gruson Works, built to their own designs. H. Ehrhardt in Dusseldorf and Zella St Blasii, is also placing several kinds on the market and exporting them to England.

Metal band saws are used mainly for cutting off bars, and for shaping parts of machines having straight or curvilinear outline, out of copper, brass, iron or steel plate. In the latter class of work the material is handled as in producing fretwork, while straight cuts are made by mounting the material on automatic tables. Band saws are used for metal up to 30 inches thick.

Sketches Figs. 1 and 2 show how forks or gaps in connecting rods and crank shafts are cut, thereby saving considerable forging. In locomotive frames and valve links the shaper is replaced by the continuous action of the band saw. The slight waste of material may often be another important consideration. Application of the saws to various work has caused the construction of forms resembling wood band saws more or less, still varying from them in essential particulars.

Figs. 3 and 4 show forms as constructed by B. & S. Massey, of Openshaw, near Manchester, England; Fig. 5 shows that of Noble & Lund, of Felling-on-Tyne; Fig. 6 that of Greenwood & Batley, of Leeds. Fig. 7 is the form built by Fried. Krupp at the Gruson Works. Figs. 8 and 9 show detail drawings of the Ehrhardt types; while Fig. 10 illustrates the French design of Panhard & Levassor.

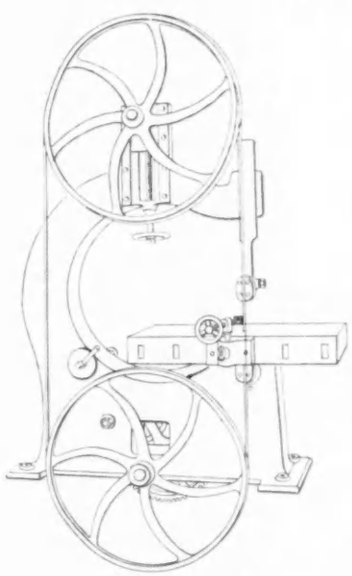
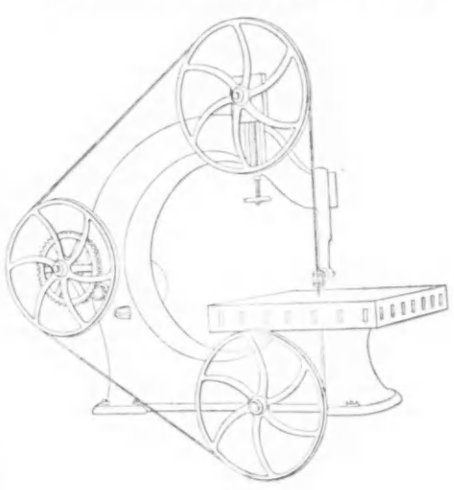


Fig. 3.



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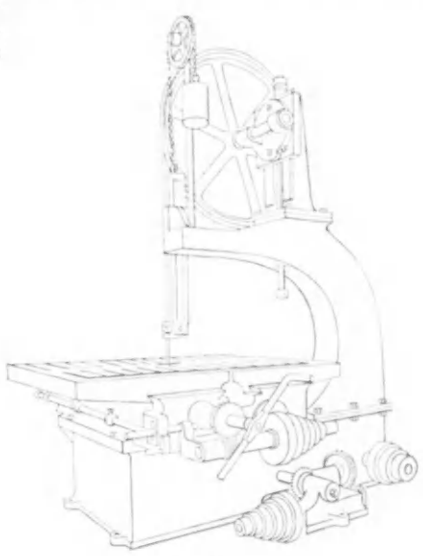

Fig. 5.

The frames are in all cases cast hollow and of great rigidity; the Greenwood & Batley machine, Fig. 6, is noted for its heavy, yet graceful forms. Noble & Lund, Fig. 5, make the table, the overhanging arm and the stand for the upper band sheave each of one piece, making transportation much easier, but first cost greater. In Fig. 10 the stand and table are also made of two separate pieces.

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†Revue Générale des Chemins de fer. 1886; Volume 9, page 259.

The designs of Ehrhardt, Figs. 8 and 9, differ in many respects from all the others. The stand carrying the table resembles a lathe bed, and the post carrying the guide sheave that of a slotter, and they are separately bolted to a bed plate. The slide carrying the upper sheave is not attached laterally, but centrally, on the post, the same as in Figs. 5 and 7, while the arm guiding the saw is twisted laterally. This secures the advantage of axial strain on the post without producing a bending moment. The appearance of the Ehrhardt machines shows how careful design modifies a type originally adopted for wood-sawing. As in wood saws, the lower sheave is the driver, although an intermediate reducing gear must be introduced to obtain satisfactory slow speeds, between the cone pulley and the driving shaft. Two spur gears are generally used for this purpose, although a worm is used. in Fig. 8, and a sprocket chain and wheels in Fig. 9.

The latter design makes it possible to remove the sprocket chain, by taking out one pin; and then, by attaching a connecting rod, an oscillatory motion is imparted to the lower sheave. The sheaves are cylindrical, but without flanges in all designs except those of Ehrhardt and of Panhard & Levassor; a rubber or leather covering serves to hold the band saws in place.

The diameter of band sheaves is chosen as large as possible; it is about 49 inches in Fig. 9; 47⅞ inches in Fig. 5; 40 inches in Fig. 6; 39¼ inches in Figs. 8 and 10. Though Krupp makes some of them 58⅞ inches, Fig. 7 shows one of but 29½ inches in diameter. Large sheaves decrease the strain on the saws and permit larger work to be placed on the machines. Anything more than 58⅞ inches, corresponding to a piece of work 55 inches, does not seem practicable. Aside from the fact that a larger diameter increases the length of saw band, the machine also assumes unwieldy proportions. If a great length of overhang is desired a third sheave can be introduced, as shown in Fig. 4, in which with sheaves 43 inches diameter, an overhang of 59 inches is obtained. A similar machine built by Geo. Richards & Co., of Broadheath, near Manchester, has three sheaves of 37½ inches diameter, the middle one shifting horizontally, the lower being driven, and has a free space of 53¾ inches. In the other machines illustrated the clearance is from 40 to 24 inches, and clear height for work 12 to 8¾ inches.

There is nothing noteworthy about the details of lower sheave or driving mechanism; but the details of the upper sheave have many peculiarities. The bearings are supported by a sliding carriage, adjusted by a screw, vertically, according to

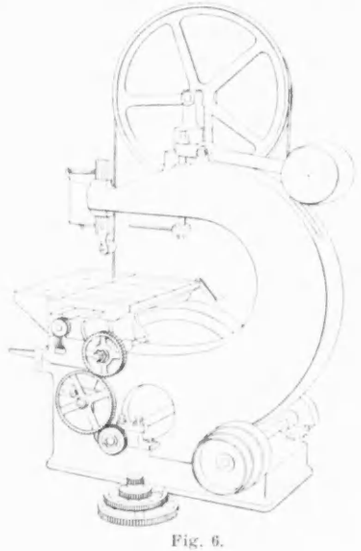
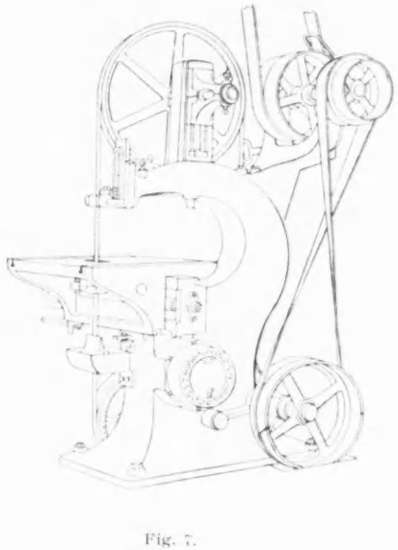


Fig. 6.



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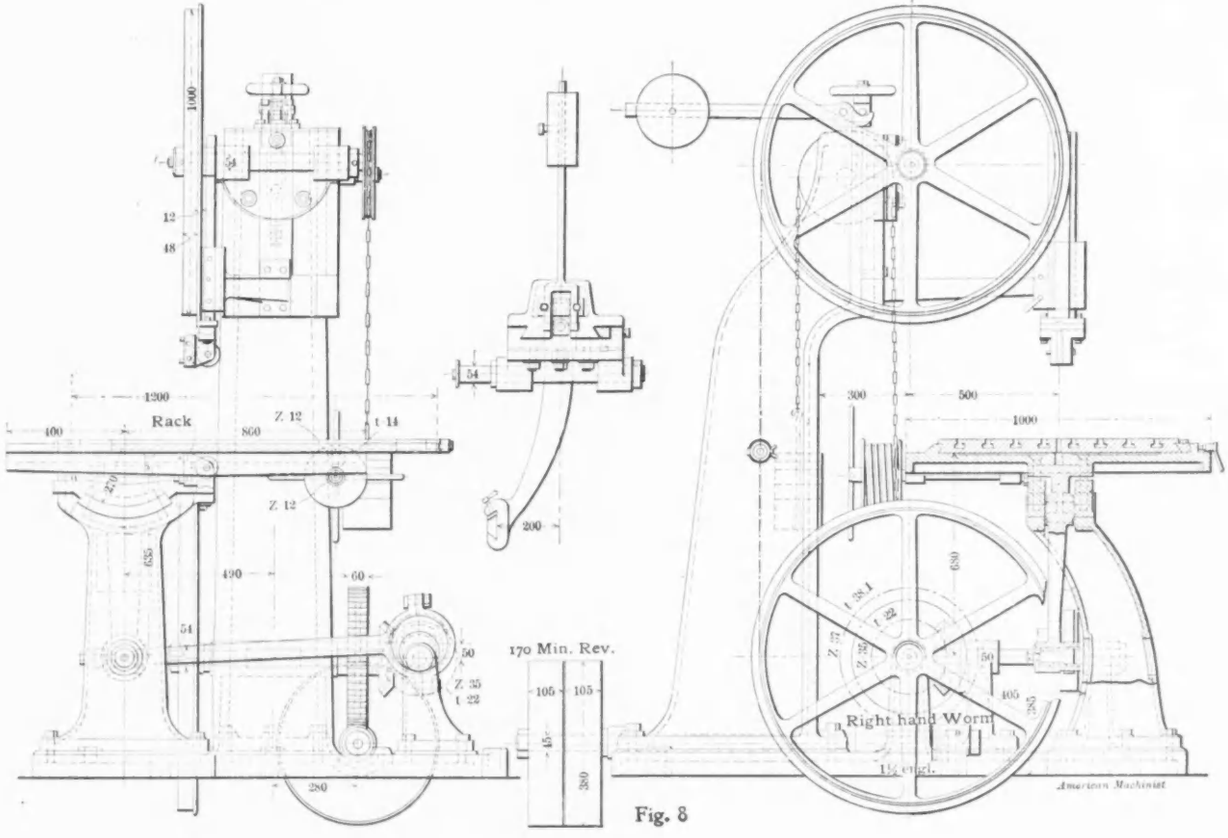

Fig. 8

the length of saw. In Figs. 3, 4, 7 and 10 this carriage is also used to strain the saw, and to take up slack due to expansion of saw when heating and slacking off upon cooling after stopping the work. In others this is secured by an automatic tension, by balance weight, coil or flat springs. In order to provide for parallel adjustment of sheave spindles many machines permit rotation of the upper spindle in a vertical plane as shown in Figs. 5, 8 and 9. In Fig. 7 this same result is obtained by the use of a spherical bearing in which the rear spindle rests, and which is tilted by two screws. In most cases the sheaves are overhanging, while only Greenwood & Batley, in Fig. 6, provide a forked out bearing.

The saw band is guided laterally by cheek pieces of cast steel or bronze, which are usually so adjusted as to fit the saw closely, one pair being above and the other below the work to be cut. The upper guides are carried on a slide, adjustable for height of work. Fig. 11 shows detail of the guides in the Ehrhardt machines. Noble & Lund balance the weight of the slide by a chain, roller and balance-weight, as in Fig. 5.

Krupp, Fig. 7, replaces guide cheeks by rollers, and also uses a wiper or stripper to remove all chips and cuttings so that they do not injure the rubber or leather covering on the sheaves. Greenwood & Batley use guides against the sides and back of the cutting as well as the free-running part of the saw. Special care is to be taken that the back of the saw when cutting is not bent by the pressure of the cutting teeth against the work. These back guides are generally part of the side guides; but it does not appear sufficient, as in Figs. 6 and 10, to provide a plane surface for this; heating becomes excessive and a groove is worn in the guide in a short time. It is much better to provide cast-steel rollers with axes parallel to those of the sheaves, as in Figs. 5 and 11, although they wear rapidly, because the contact between them and the back of the saws is in the point of tangency only. It is well known that hyperboloids of revolution with oblique axes have been used as guides for and are revolved by the band saws. These provide ample bearing and cooling as well. But the problem is solved in a much simpler manner by Massey, who provides a hardened steel disk with a horizontal spindle at right angles to the shafts of the band sheaves. The back of the saw bears against the plane surface of the disk at a distance from its center, which is thereby revolved when the machine is operated.

To cool band saws, the lower sheave is allowed to dip in a tub of soap water, or cooling water is allowed to drip on the cutting point; many cool by water only when cutting hard steel.

The table is either rigid, as in Figs. 3 and 4, or is fed by hand or automatically. In the first case the workman moves the work by hand, at the same time using a fork to guide the saw. The table is then cast solid, merely having a hole to pass the saw. If rectilinear cuts are to be made on a rigid table, an auxiliary device, as in Fig. 3, is provided, which consists of a threaded block secured to the table and a screw with a hand wheel, which advances the work.

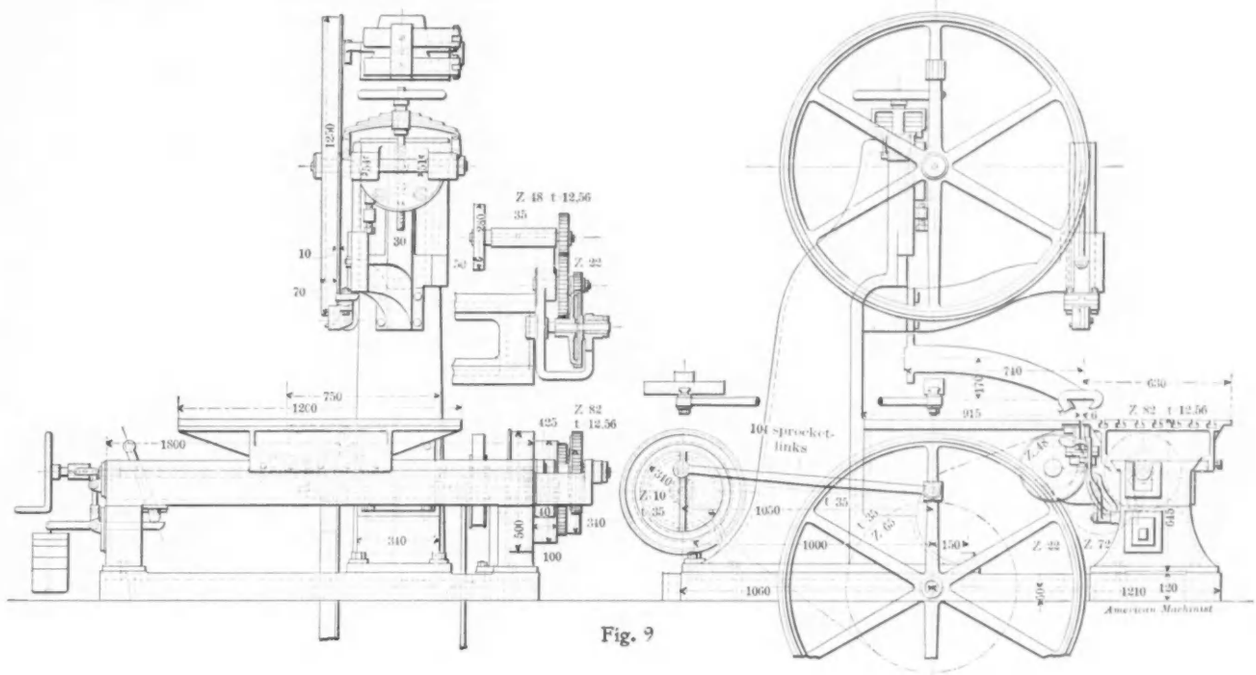

Fig. 9

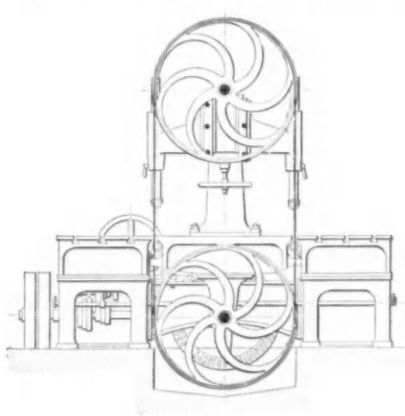

Fig. 11

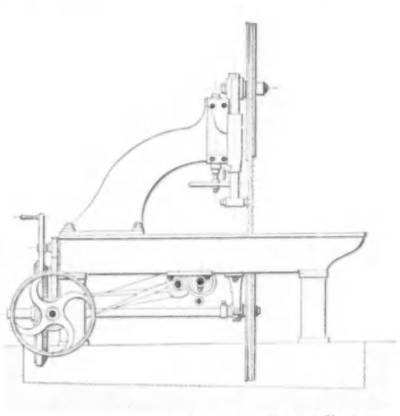

Fig. 10

This design is intermediate between fixed and movable tables, which are used when the saw is to be used mainly for straight cuts. The table is provided with holes or slots for bolts to secure the work. The movable table is also frequently cast in one solid piece, as in Figs. 7 and 9, though it is more convenient to have it in

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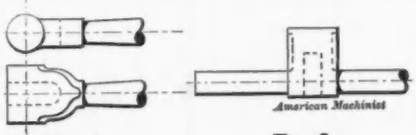

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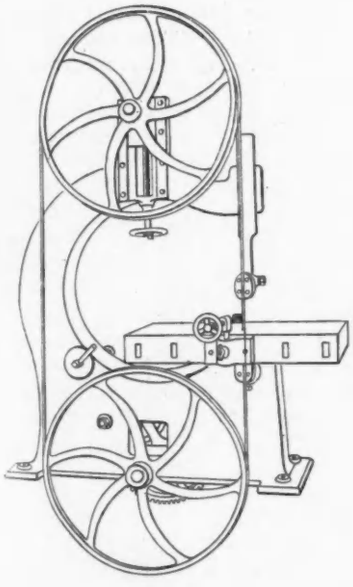

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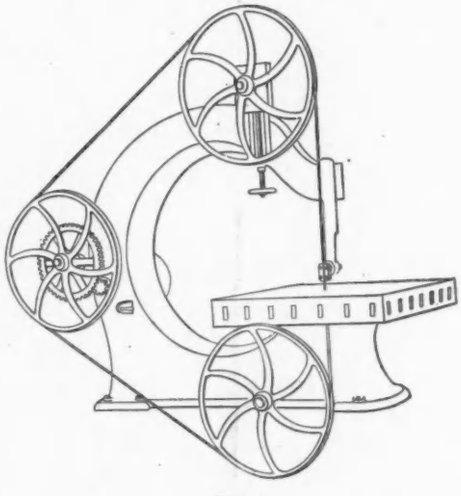

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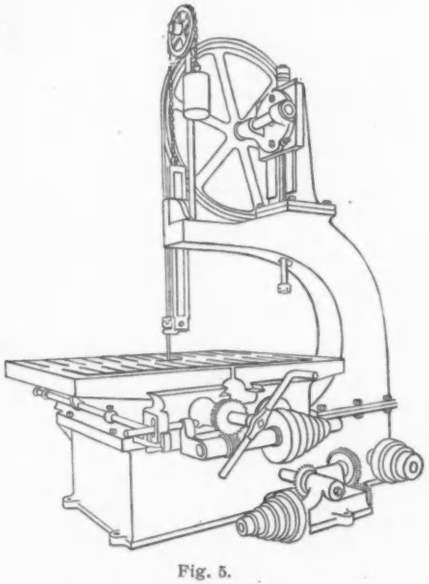

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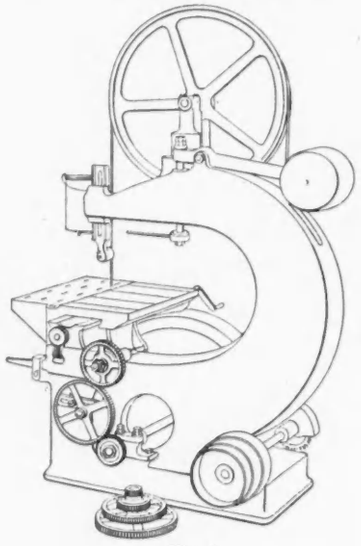

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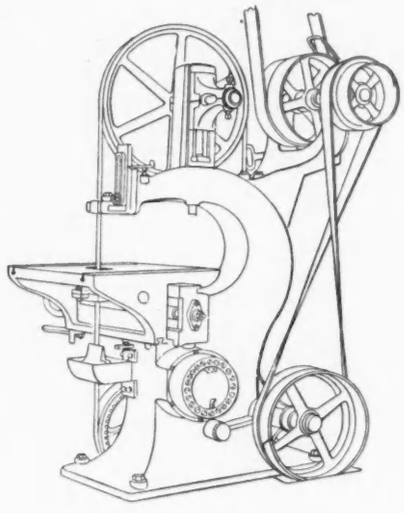

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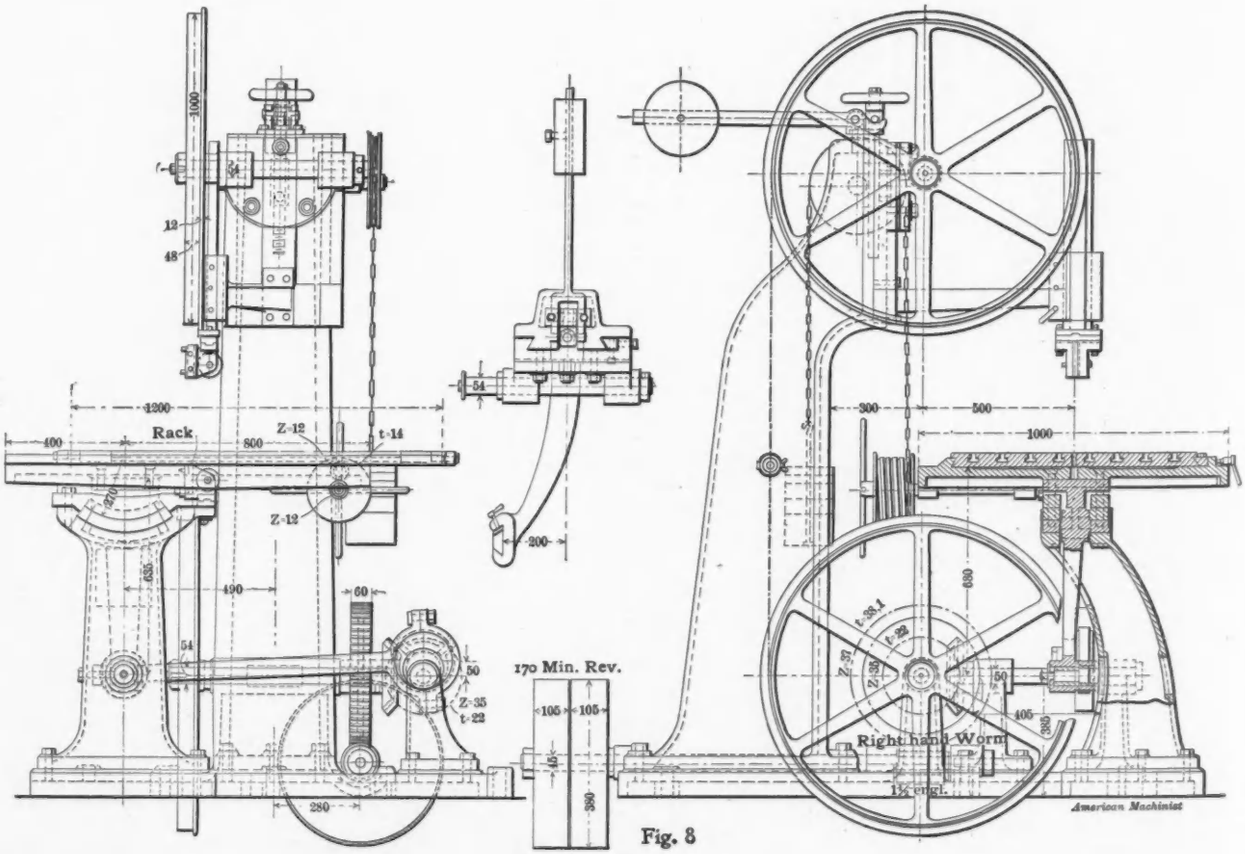

Fig. 8

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The table is either rigid, as in Figs. 3 and 4, or is fed by hand or automatically. In the first case the workman moves the work by hand, at the same time using a fork to guide the saw. The table is then cast solid, merely having a hole to pass the saw. If rectilinear cuts are to be made on a rigid table, an auxiliary device, as in Fig. 3, is provided, which consists of a threaded block secured to the table and a screw with a hand wheel, which advances the work.

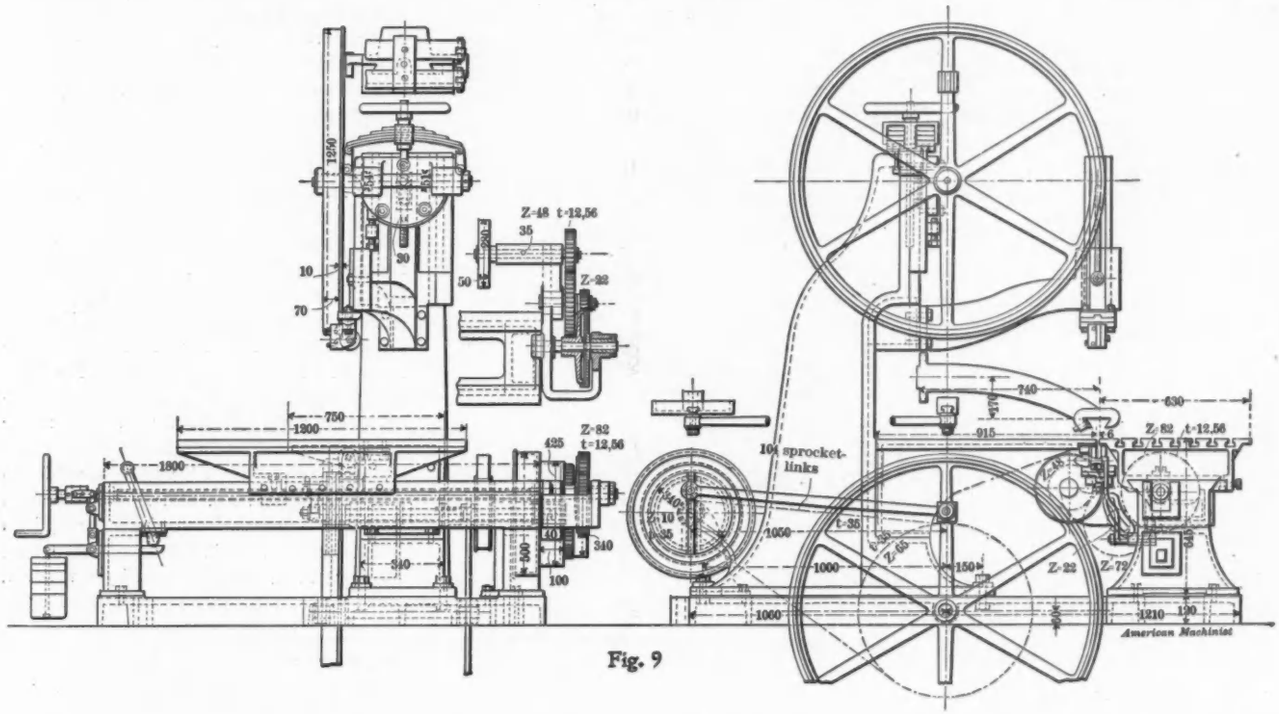


Fig. 9

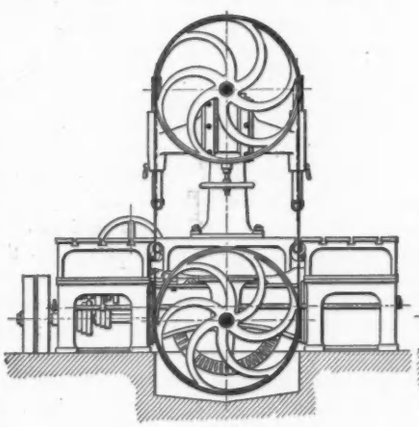


Fig. 11

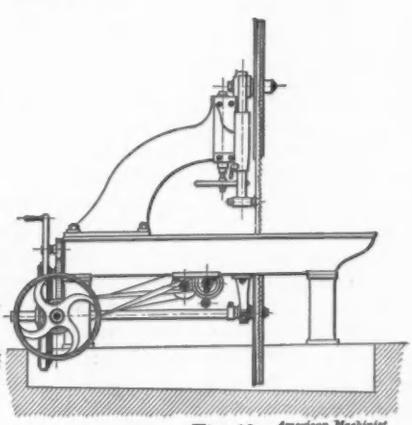


Fig. 10

This design is intermediate between fixed and movable tables, which are used when the saw is to be used mainly for straight cuts. The table is provided with holes or slots for bolts to secure the work. The movable table is also frequently cast in one solid piece, as in Figs. 7 and 9, though it is more convenient to have it in

two pieces when applying a new saw. In Fig. 6 the two pieces are provided with a hinge on one side, having a bolt on the opposite side, which passes through two lugs. The outer part can be swung easily like a bracket. The table in Fig. 5 is also in two parts, which are bolted together on one side. The tables shown in Fig. 9 are totally different, and the exterior part

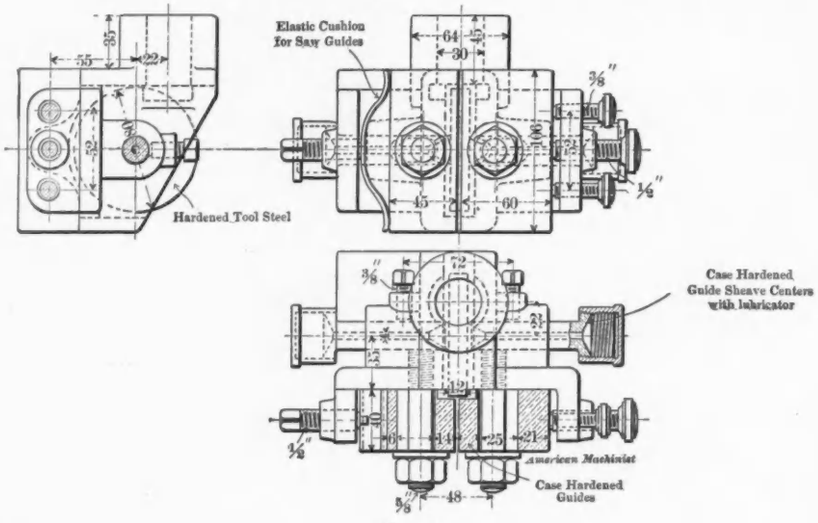

Elastic Cushion for Saw Guides
Hardened Tool Steel
Case Hardened Guide Sheave Centers with lubricator
American Machinist
Case Hardened Guides

Fig. 12

only, on which the work rests, is moved, while the inner is used to catch the cuttings.

The tables run in V or flat grooves, as in lathes, and are rarely adjustable. In Fig. 7 vertical and horizontal guide surfaces are provided. In Fig. 5 each has a guide.

The automatic feed is the detail which gives the designer the most trouble, much more than in other machine tools. In machines with cutting tools excessive feed may break them, but a little forging and grinding produces an equally good new tool. But in band saws the strains produced by cutting are supplemented by tension and distortion in passing around the sheaves. Danger of fracture is therefore much greater. Should the band saw break, it becomes necessary to anneal the ends, to scarf, braze and file them to the correct thickness with the greatest amount of care; this takes time and expert work. Wood band saws do not break so readily, because the material offers less resistance and is usually of uniform dimensions. Besides, wood is usually fed by hand, and the touch of the workman determines speed of feed. It is different with metals: Take a rolled shape, for instance, where a constantly varying section is touching the saw, which, besides, has different degrees of hardness. Allowance must also be made for the fact that the saw grows duller and duller. Hence, an arrangement should really be provided which would regulate the speed in an inverse proportion to the resistance offered.

An examination of the illustrations shows that the Ehrhardt design alone meets these requirements. Usually the feeding device is so arranged as to be regulated for the particular kind and size of material to be cut, but once adjusted, remains constant during a cut. Noble & Lund use cone pulleys for feed regulation, as in Fig. 5. A pair of bevel gears is driven by the shaft of the lower sheave, which operates a sextuple cone pulley by means of a gear and pinion. The pulley

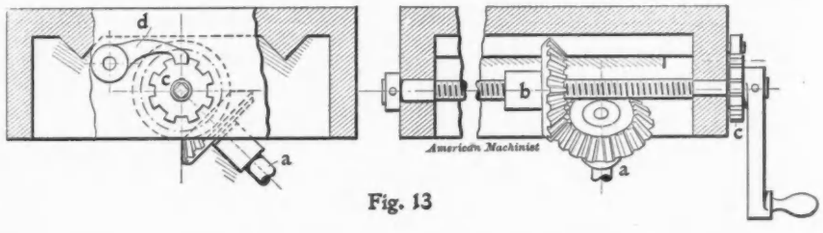


Fig. 13

shaft carries a worm which again operates the feed table. Shifting the pulley shaft throws worm and wheel out of gear, and the table can be fed by hand or automatically beyond a certain point, using trippers to limit the motion.

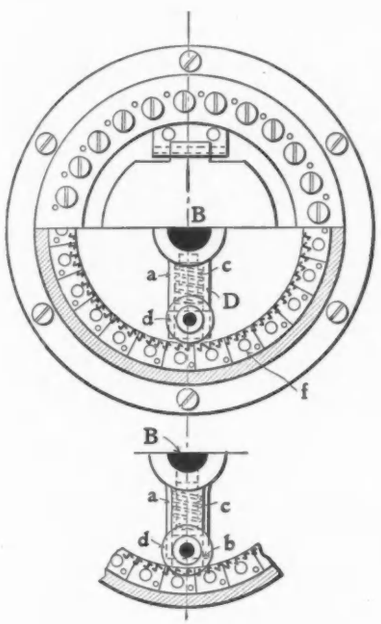
Greenwood & Batley, Fig. 6, use a train of gearing as is customary in lathes, driving a pair of bevel gears, with worm and worm wheel, with an automatic shifter or tripper. A similar but more graceful design is seen in the machines built by Massey, Fig. 4. The automatic feed is controlled by a jaw clutch, which locks the bevel gear on the shaft of the second cone pulley. Special praise is to be given to the change from power to hand feed; Fig. 12, drawn from memory, shows it. When feeding by power, a bevel wheel *b* is driven by another *a*, which, having an internal thread, fits the driving spindle. The spindle advances, carrying the table, when prevented from turning; it is held by a pawl *d* and ratchet *c*, which is fixed on the feed spindle. When the pawl is released and the feed mechanism thrown out of gear, the table can be fed by hand.

The machines shown in Figs. 3 and 4 have another peculiarity, viz., that their tables can be tilted, enabling cuts oblique to the base of the work to be produced; the ways are carried by journals, so that the worm and gear provided with hand wheel allows tilting of the whole. The axis of revolution coincides with that of the feed screw.

The designs thus far described have this error, that the feeds can only be changed in a few fixed abrupt ratios. Krupp's machine permits many gradations of feed. The device they use is shown in Fig. 13 and does not advance steadily, but by jerks or jumps. It consists of an escapement, which is actuated by a geared clutch. A horizontal intermediate shaft *B* and another *A*, vertical, transmit the rotation of the lower sheave to the feed screw of the table. The intermediate shafts are connected by bevel gears, but the gear *C* on the horizontal shaft is loose on it. On its back it carries ratchet teeth on its inner circumference, and a pawl *D*, fixed on the shaft *B*. The pawl would drive the bevel gear continuously were it not released occasionally; this is done as follows: The pawl consists of a crank arm *a* and of a toothed hinged hook *b*, which is bedded in a prismatic bearing, and is movable in a radial direction and forced outwardly by a spiral spring *c*. The action of this spring *c* is, however, counteracted by a roller *d*, which is carried by the hinged hook or pawl proper and travels on a circular path. The latter consists of twenty-five touching blocks *f*, which can be drawn back singly by screws *g*. When the path of the roller is interrupted, the spring causes the toothed pawl to engage in the ratchet teeth, the bevel gear *C* is carried along, and the table moves. At the end of the gap the roller again takes up its motion and the pawl is released. By adjustment of the blocks any desired variation of feed may be obtained. A coupling is carried on the feed screw to stop the feed, and can be disengaged by hand or by power, by a tripper provided for that purpose.

The action of this mechanism can be represented by Figs. 14 and 15, in which the feed *b*, is made equal to travel of saw to simplify the diagram, but is in the opposite direction. Feed *b* and speed *a* are then the components of resultant *C*, having the angle δ which represents the angle of entrance of the saw teeth. With similar shape of saw blade the work of teeth becomes less as this angle decreases, but at the same time the chips are released with increasing difficulty. Therefore δ is to be so chosen that pressure on saw teeth and resistance of chips lie between

certain limits. The jerky feed of the Krupp saw, Fig. 7, causes a sharp cutting angle between teeth and work; hence, the pressure is great. Then the teeth advance a distance *d* without feed; hence, the resistance of chips becomes great. Therefore it seems probable that the saw blade is subject to much greater strain than in ordinary feed mechanisms, supposing



equal work of cutting in all cases. The suggestion that the jerky feed occurs in very small amounts does not seem a good one, considering the great sensitiveness of saw blades. The principal advantage besides the great number of different rates of feed is that it can be adjusted without stopping the machine, although this can be done with greater facility when using friction disks.

In all these contrivances the workman can easily see when the feed is to be changed for varying length of cut; but it becomes altogether a different matter when the saw becomes dull or the work varies in hardness. In these cases the feed should depend upon the resistance offered to the saw, and devices for this purpose are well-known as applied to circular saws, which are carried on a pendulum with movable weight on the free end of arm. This method is found in American band saws. Fig. 16 shows such a device. In this the chain drum carries a pinion on its shaft which drives a rack on under side of table. The workman revolves this drum, thereby winding up a chain carrying a weight before starting the machine; it must be mentioned that the bed under the table is given an oscillating motion by a double crank. This causes the saw to constantly touch at different points instead of remaining in a rut once started, producing a motion similar to that of a hand saw.

The Panhard & Levassor saw, Fig. 10, is quite different from all the others, in that both parts of the saw cut at the same time, and the table is fixed, while the saw is fed along by turning a hand wheel which operates the feed mechanism. This saw is useful on very heavy work, such as heavy plate, locomotive frames, etc.

The most important consideration for

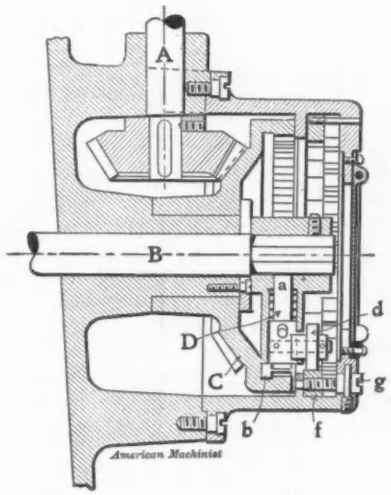


Fig. 15

neat and economical work with these machines is the quality of the saws. The following information is given by the Schramberg Watch Spring Factory, of Wurtemberg: The material should be tough high-carbon cast steel, which is cast into crucibles and is then forged and rolled. The hardness should be about that of watch-springs, and should not exceed this greatly, or else they become brittle. An American concern makes saws in which the teeth alone are hardened.

The width of the band depends upon the work to be done and upon the thickness of the metal to be cut. Wide bands are used for straight cuts and thick blocks, while narrow bands are used for curved cuts and thin plates. The thickness usually increases with width of blade, although it also depends upon the diameter of sheaves; the breadth varies between ½ inch and 1¼ inches, although blades of 3-inch width are used; the thickness never exceeds .08 inch and is generally from .03 to .04 inch.

The number and shape of teeth depend mainly upon the kind of work to be done. The Bordeaux tests mentioned above determined spacing of teeth of about .12 inch for cast and wrought iron and steel. A later authority, "Railroad Gazette," 1889, page 585, however, states this dimension should be .07 inch, thus agreeing with the experience of the Schramberg Works, which, however, uses much coarser spacing for soft metals, such as zinc, lead, etc., reaching .10 inch. A saw band of H. Ehrhardt was 1¾ inches wide; teeth spaced about .16 inch. The shape of the teeth should be slightly projecting or rectangular, but the root of the tooth should have a large fillet, and never be square, as the latter causes fractures. The Bordeaux tests gave for the best angle of teeth $x = 50°$, and for the clearance angle $y = 33°$, x is frequently made 60° and $y = 30°$. But as these angles depend upon the ratio between speed and feed no statements of angles are complete without giving the latter. The teeth and band are either of one thickness, or the former are slightly thicker than the latter. In the latter case, setting of the teeth is unnecessary, although even then commonly resorted to. The Schramberg Works recommend to set one tooth to the left, the third to the right, and leaving the intermediate one normal,

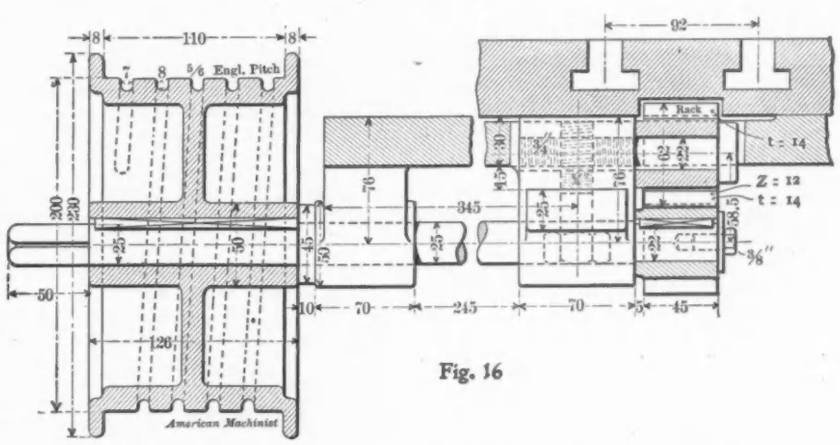


Fig. 16

which then does the greater amount of cutting until ground down to the plane of the others, after which it serves mainly to clear the chips. Grinding and setting is generally done by machines, and in the report of the Bordeaux tests the use of emery grinders was made a primary condition in the economic use of band saws.

The following table gives the results

of cutting of different materials and speed of saws of different types:

TYPE.	Speed of Saw.	WORK IN SQUARE INCHES. MINUTES = FEED X LENGTH OF CUT.					H. P.
	Ft. per Min.	Hard Steel.	Soft Steel.	Wrought Iron.	Cast Iron.	Bronze.	
B. & S. Massey	210	.....	.....	1.08 to 1.39	.....	.....	.....
Noble & Lund	180.5	.....	.....	1.00 to 2.00	.....	2.00 to 4.00	.....
Greenwood & Batley	187	0.27 to 0.41	0.39 to 0.52	c.67 to 0.84	.....	.....	.....
Fred. Krupp, Gruson	61.8	.....	0.31 to 0.40	c.46 to c.50	0.60 to 0.70	0.60 to 0.70	0.15
H. Ehrhardt	177 for cast iron and bronze. 118 for wrought iron .78 for steel.	1.50	1.60	1.11	1.55	3.35	

The following table gives results obtained by Panhard & Levassor in cutting out test pieces from locomotive tires, giving depth, length and time:

Cut No	Height in Inches.	Length in Inches.	Time, Minutes.
1	2.48	1.26	22
2	2.60	1.26	22
3	1.77	1.26	13
4	1.18	1.26	7

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The Bottom of a Foundry Cupola.

BY L. C. JEWETT.

Considerable space in your valuable paper has been given (and wisely, in my opinion) to discussions of the best methods of charging cupolas, size and location of tuyeres, as to height, pressure of blast to obtain the best results, etc., etc.; but I have never noticed mention of how the sand bottom should be treated. This is an important feature in cupola management, and can cause a great deal of trouble if not properly attended to.

If not encroaching on your valuable space, I will relate an experience I was once shopmate with. A number of years since in a leading foundry in New England where I got employment, it was almost a daily occurrence to have a leak in the bottom of the cupola; in other words, the hot metal cut through the bottom. I can see the foreman now, complacently seated on the end of a many-scarred plank, with a wooden made-on-purpose horse for a fulcrum, and a large poultice of clay on the opposite short end of the plank, pressed up hard against the wound made by the hot metal, that had cut through sand and iron doors.

The first day of my advent in that foundry, a run-out in the cupola bottom occurred. In most foundries this accident is rare, and when it does occur, it is conducive to considerable excitement, attended ofttimes, as the French say, with features "comique"—for every man's and boy's soul is in arms and eager for the fray; each one feels that he, and he alone, knows how to stop it, or at least will feel guilty if he don't do something. So orders are hurriedly and vociferously given to "shut off the wind," "tap her out," "get another ladle under," and the men crowd and jostle into the narrow cupola room, some with buckets without water, others with shovelfuls of sand, which is vainly thrown at the leak. Others, putting large pieces of clay onto rammers, start for the leak. The fellow with empty bucket has discovered that fact and starts to fill it with water, collides with the men with the clay-loaded rammers and knocks the clay off. Meantime, from a small it has grown to a large leak; the hot metal accumulates under the cupola, with rapidly increasing radiating surface.

By this time the empty bucket comes back full of water and, with more zeal than judgment, is heroically thrown at the leak. Of course, it misses the leak, but is a "howling success" in coming "kerplump" on top of the pool of hot iron, and the leak stoppers are nearly suffocated with scalding steam. This is the average scene where such leaks are rare.

But I discovered that stopping leaks in a cupola bottom was susceptible of being systematized, in fact, could be made artistic as to method of stoppage. When this particular leak broke loose the foreman resignedly stopped the blast, told the melter to draw off all the iron he could save, went deliberately to the rear of the cupola room, took a plank and the beforementioned wooden horse, put horse and plank in place and called to the melter for the mud. The melter produced a cheese-shaped cake of stiff clay, kept in a damp box, "in stock;" it was pressed up against the leak; foreman sat down leisurely on the long end of plank; the melter covered the hot iron with sand, got under cupola, tucked up the clay with a hammer, nice and neat, and sang out "All right; let her go!" And we went, as if nothing very unusual had happened; and on inquiry I learned there was nothing unusual about it, as it was considered a pretty lucky heat if she didn't "leak in her bottom," as the melter expressed it, so they were always prepared for emergencies.

A few days later the tuyeres bunged up when the heat was half over, and we had to drop the bottom. Shortly after, a shopmate asked if I ever saw a cupola full of boiling water. On looking in the charging door, there it was, sure, full to the door, a veritable volcano, a rare and unusual sight to see. The charge had hung up, and water was introduced to shrink things, so it would drop; but it had to be taken out the same way it went in that day.

I had given considerable attention to cupola practice, and while I had never been shopmate before with this kind of accident, I thought I knew their cause and prevention. In order to be certain and have my suspicions confirmed, the melter was requested to let me see him prepare his cupola, as I wanted to learn that trick, as it was a pretty good thing to know how to do. After the bottom doors were up, he put in about 2½ barrows of new fine molding sand; then got inside, with a heavy rammer. He pounded the 3½ or 4 inches of sand so hard that every blow could be heard all over the shop; then came outside and luted with soft clay every crack and crevice around the bottom, and finished the thing off by throwing a bucket of water in the breast opening. There was a beautiful leak that day. The melter informed me in a confidential whisper that he must have missed some place when he calked her up, and he gave me a knowing "Don't-give-me-away" nod and wink.

After a few days' deliberation to how, if kindly or otherwise, instruction would be received, I asked the melter if he would like to learn how to prepare his cupola so that leaks would be rare, if ever; also how to prevent the tuyeres from getting bunged or closed up early in the heat, and various other troubles he seemed to be beset with. He assured me he would, and that he had never been told a thing, "and the Lord knows I am doin' me livil best." "Then," said I, "when you put in the next bottom, get the sand from the cinders-tumbling mill, if there are cinders in it, it will not harm it, but make it more open; put very little water to it, but temper it even; have it like damp ashes. Before going into the cupola, take that heavy rammer and throw it in the river, or some where where it will never get into the cupola unless on top of the fuel, through the charging door. When you get inside, to dress the sand, tuck it evenly all around the outside with the ends of your fingers; then tread the sand all over, evenly and smoothly; it will be firm enough. Never put mud on the bricks over 1½ inches thick, no matter how much burned out; if much thicker, it will not dry through before the wind goes on; and if not dry, it will flake off, from the steam forcing it off, and be converted into slag to plague away and help bung up the tuyeres. Put the breast in arching, both inside and out; do not have it over 2 inches thick through tapping hole; 1½ inches are better, if you are careful the first two or three taps. If you follow these instructions, you will avoid most, if not all, the important troubles you are now suffering from. You have been making the bottoms hard, of close sand, and wet; thus stop-

ping up every crack on the outside to prevent the steam from escaping, and it forced the sand away, by boiling the iron until the bottom doors came in contact with the melted iron and it cut through. The tuyeres bung up from the same cause. You hold the cupola until you have some metal accumulated; the tuyeres are quite low; the liquid iron is agitated, thrashes around from the bottom being too hard and too much wet mud on the sides, comes in contact with the spent fuel around tuyeres, congeals, bungs up tuyeres, and there you are again."

The sand bottom of a cupola should be made, as far as density is concerned, the same as a mold, so metal will lie quietly on it. The dryer and more open the sand is, if trod in evenly, the better it is prepared for the purpose. The metal will put a skin on it, so it will not move.

That plank and wooden horse became very much in the way in a few weeks, and were finally consigned outdoors; there was no more use for them while I remained, and if afterwards I never heard of it. The foreman informed me just before I left that they had "had first-class *luck* with the cupola lately."

Boston, Mass.

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Plain Back-Geared Milling Machine.

The accompanying illustration is of a milling machine intended for machine-shop operations and manufacturing.

The illustration makes the construction of the machine clear, and we need only call attention to the fact that the shaft, by which the platen is moved by hand, extends to the front of the knee and is squared for the reception of the crank handle, the shaft being connected to the screw by helical gears. The nut is formed in the lower side of the platen itself.

The arrangement of the "harness" or yoke, by which the overhanging arm can be tied to the knee, is such that arbors and cutters can be removed from and put into the machine without disturbing the adjustment. By giving two bolts part of a turn, the outer arbor support, being slotted, can be removed, and the center support, being in two parts, the lower portion can be disconnected and removed with the arbor, the whole coming out through the opening in the harness. The harness can be bolted to the saddle, as well as clamped to the knee, when desired, and is shown thus bolted.

There are seven rates of feed, driven by a relatively high speed and therefore powerful belt, and the feed is tripped automatically in either direction. One turn of the crank moves the platen one inch.

The base has a raised edge around it to catch and retain lubricant used on the cutters which may pass the platen, and this conduces to economy and a clean floor.

The machine is made by the Kempsmith Machine Tool Company, Milwaukee, Wis.

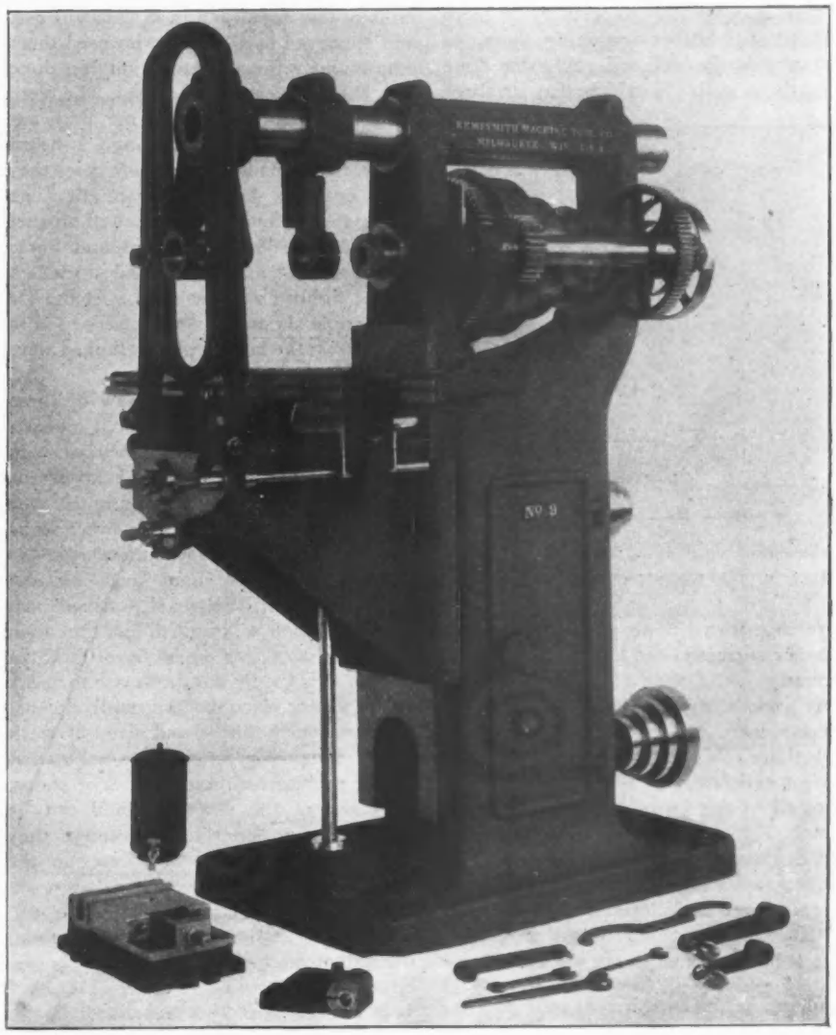
Literary Notes.

A TEXT BOOK OF MECHANICAL DRAWING. Part III. Machine Drawing. By Gardner C. Anthony. 50 7¼ x 5½ pages; 40 figures and 16 full-page plates. $1.20.

This is one of the most useful and sensible books on this subject that we have seen. It gives the kind of instruction that the student draftsman needs, and for the want of which so many draftsmen fail. We refer to such things as the arrangement and selection of views in order to show the construction of the machine and the relation of its parts and to the methods of figuring drawings plainly and without obscurity. Such things as these comprise the draftsman's trade, and not the picture-making to which so many drawing-books devote themselves. With the companion volume on Mechanical Drawing recently noticed in these columns, the student is in possession of all needed instruction on this subject. The Mechanical Drawing teaches projection and intersections, and the Machine Drawing gives about all that can be profitably taught on its subject through books. There are a few things about the book which we do not like, notably the use of conventional sections to indicate materials, but in spite of this we can recommend it without hesitation.

NOTES ON MECHANICAL LABORATORY PRACTICE. By C. H. Benjamin. 104 pages; 6 x 9 inches; 29 illustrations. C. H. Holmes, Cleveland, O.

This book has been prepared for the use of the students of the Case School of Applied Sciences. It comprises such instructions as must be given to every student on the construction, care and use of the instruments used in mechanical work. The collection of such points in a book cannot do otherwise than economize time and labor on the part of the instructor. Correct forms for logs and reports of tests with the instruments described are included in the book, making it a useful manual of reference for the testing engineer or student.



PLAIN BACK-GEARED MILLING MACHINE.

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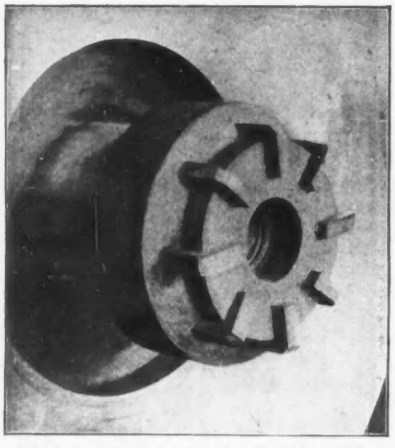
Geo. H. Barrus and William S. Monroe have opened an office in The Rookery, Chicago, as mechanical and electrical engineers and experts.

Inserted-Tooth Mills.

The making of inserted-tooth mills by casting a gray-iron mill body around the mill teeth properly placed in a sand mold, has often been proposed, and perhaps often tried; but the first actual examples I ever saw were made at the Link Belt Engineering Company's shops, Chicago, late in 1894, and were considered an out-and-out failure. The teeth were said to be loose, and it was also said, that the steel in the teeth had been ruined by overheating while in the mould, and that it was an impossibility to temper the teeth without still further loosening them, so that absolutely nothing could be done with these mills, of which two or three



MILL WITH TEETH CAST IN PLACE.

were shown me, none of which, if I remember correctly, had ever been bored or ground.

At Sweet's Straight Line Engine shops I found, last April, such mills in constant and thoroughly established use, giving perfect satisfaction. I think these mills were all of the form shown in the hand sketch, Fig. 1. I did not obtain particulars of these mills at that time, but in response to an inquiry by mail, Professor Sweet writes as follows:

"Replying to yours of the 22d, only just at hand, I have to say we use for our milling cutter teeth (which are all for end milling) pieces of triangular steel of Mushet self-hardening, and other makes, and also of the best tool steel. Our method is to cut off pieces of the right length, 2 or 2½ inches long, and set them, cutting end-down, in a properly formed iron core-box bottom, and pack around them core sand to hold them in place; when this core is baked, the teeth are firmly held in their proper position. The pattern for the cast-iron part has a core print to correspond with the core, and when the iron is cast, some extra hot iron is poured through, as is usual in casting in steel; the teeth are firmly secured in place. The casting anneals the free ends of the projecting teeth so they can be turned up when the shank of the cutter is turned up, or, if too hard, ground roughly in shape on the emery wheel and then ground like any ordinary cutter in the tool grinder. The whole thing is then heated up and air hardened if of the self-hardening steel, or hardened in the usual way if of the high-grade steel. One is liable to have to heat hotter to harden; but whether that is due to decarbonizing of the teeth in the sand, or due to the difficulty in quickly cooling the heavy mass, I don't know. JOHN E. SWEET."

Professor Sweet's mill was shown in the issue of April 30th, page 449.

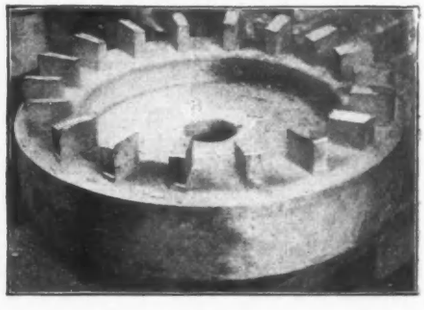
At the De La Vergne shops I found mills of this construction in constant use, and approved by the man who used them continuously for all surface milling done in a Niles traversing machine. The teeth were reasonably tight; to me they appeared perfectly firm, although I heard the assertion made that in some cases they were not so. As in the Straight Line shops, the teeth were mads both of Mushet and water-hardened tool steel, and I was informed that hardening had no effect on the tightness of the teeth. At the De La Vergne shops these mills were used in large sizes; the largest photographed were 14 inches diameter.

I should say, from all I saw of these mills with inserted teeth secured by casting, that for all end cuts they were in every way perfectly good. I know the one shown in working position in the nose of the Niles machine spindle was a good tool, and carried a good cutting edge, as I saw it put over some large surfaces which were extremely well finished, and finished, of course, in much less time than any form of planer could have done the work. It is hardly fair, however, to speak of the planer in connection with the surfacing of such shapes and sizes of work as are commonly finished on large traversing milling machines in heavy shops, as many of the surfaces could not be reached by a planer tool, although they were finished with perfect ease on the Niles machine.

If the teeth of large mills can be well secured by casting the mill body about them, that method of construction is certainly cheaper than any other; I think I saw nothing over 8 or 9 inches diameter at the Straight Line shops, so Professor Sweet's experience does not cover what can be called large mills. The De La Vergne 14-inch examples of this construction are, however, large enough to warrant experiments in constructing mills of any usual diameter by casting the teeth in place, as it is rare to make a mill of this form to cover more than about 30 inches wide at one cut. Large diameter face mills are almost invariably, so far as I have seen, made with loose teeth, with some sort of screw fastening, capable of speedy release, so that the teeth can be quickly taken out for grinding and quickly replaced. Large mills of this sort are in use at the Baldwin shops, on a driving-box surfacing machine by Sellers; and at the Pond shops, on a Pond machine, in a very large cutter diameter for facing the bottom edges of planer uprights and similar pieces. Both of these machines hold the work stationary and carry the mill spindle in a traversing head. It is not considered possible, however, to set the screw-secured teeth which are taken out of the mill body to be ground so as to cut much closer than to within a thousandth of an inch of uniform depth, while the surfaces produced by the mills shown from the Straight Line and De La Vergne shops were very good indeed, much better than I ever saw made by any mill having teeth which were removed from the mill body for grinding.

There seems to be a field of very considerable extent in which the cast-inserted method of mill-tooth securing can be made an economical factor of machine finishing, and the construction of mills by this method can hardly be regarded as a doubtful experiment in view of the successful examples of use here given.

It is, of course, necessary that the parts of the teeth which are to be surrounded by the melted cast iron should be properly cleaned and protected from rust; I think it always safe to tin any wrought-metal surfaces which are to be cast in place. It is often thought enough, however, to merely put the pieces over a rough emery wheel and set them in the



MILL WITH TEETH CAST IN PLACE.

mold of green sand, bright. In this case, if the mold stands any time before pouring, there is always a chance that the bright surface will rust, and it is well known that rust will effectually prevent anything like a union between solid metal laid in a mold and cast iron poured around it. I think it better to paint the bright work with white lead or simply boiled oil, rather than to put a freshly ground bright piece, naked, in the sand mold; but tinning is the better practice, and I have no doubt would greatly aid in securing the teeth firmly in the cast iron.

Probably this rough-and-ready and extremely cheap method of inserted-tooth mill construction will meet with strenuous disapproval from the mill-makers who follow the elaborate and costly methods of inserted mill teeth which are in common use by the leading tool-makers; nevertheless, I expect to see mills made as I have described very largely used.

HORACE L. ARNOLD.

Circular Milling.

BY C. O. GRIFFIN.

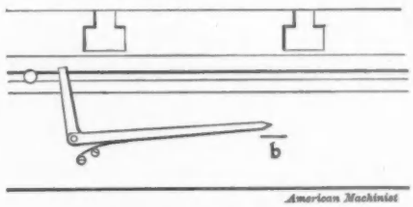
Circular milling is one of those shop processes which do not receive the attention they deserve. I have seen a few shops where attachments had been made for this class of work, and the Brown & Sharpe Manufacturing Company make an attachment to go on their vertical spindle milling machine, and this brief statement covers all that I have seen of this method.

There are, broadly speaking, two classes of circular milling, just as there are two classes of lathe work—namely, that done between centers or on a mandrel, and that done on a face plate or chuck. Most of the home-made attachments that I have seen have been for the former class of work, but this is the least adapted to that method, as the support and stiffness of the work are not in many cases sufficient for the heavy cuts which now prevail in milling. The Brown & Sharpe attachment is for face-plate work, but it goes with their vertical spindle machine, which most of us do not have. It has seemed to me, therefore, that a sketch of a successful attachment to go on the horizontal spindle machine and to do face-plate work would be of service.

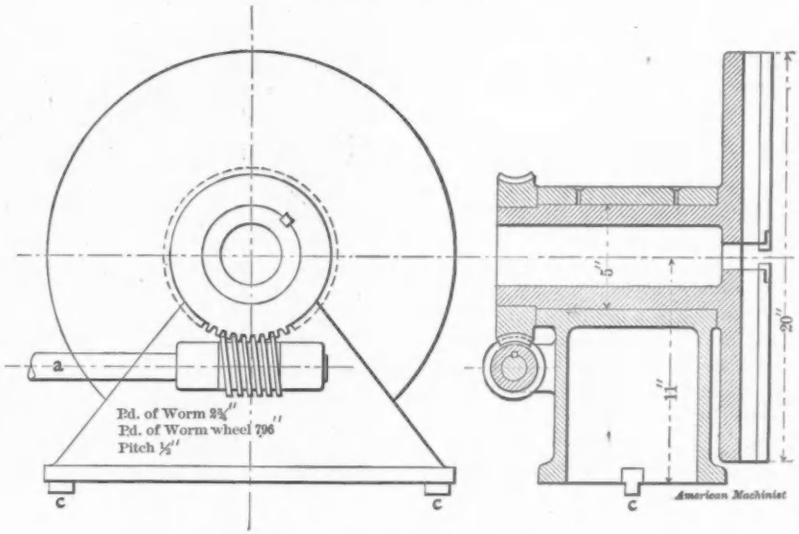
The attachment is so simple as to scarcely need a detailed description. It will be seen to comprise a T-slotted face plate with a large spindle, supported by a suitable bracket, and driven by a worm gear. The bracket is, of course, mounted on the milling machine table, and the feed shaft *a* is extended to the end of the table, where a bracket and some gears connect it with the regular feed motion. In my own case the machine used was an old-style Brainerd, having a long box guide for the table carrying a stationary screw—the nut being attached to the table and traveling with it. The gear bracket was bolted to the box guide, and the shaft was splined to permit its being drawn through the last gear of the train. With a machine of the Brown & Sharpe style, the feed shaft would naturally be extended in the opposite direction from the one shown, and would be driven through gearing carried by a bracket on the table—this gearing being operated by the ball and socket jointed feed shaft, which would be disconnected from its usual position. It will be seen at once that the circular feed must be independent of the table feed screw, which last must be left free for adjustment by hand to determine the size of the work.

Such an attachment will, of course, be used only for pieces which are made in quantities, and the method of holding such parts is by special chucks made of simple castings, with stops, set screws and binding straps, by which the pieces go at once to their places. A shallow recess will be seen turned in the center of the face plate, whose purpose is to locate these special chucks. The chucks are made with a raised hub to fit this recess, and hence can be put in place without loss of time, and the system of stops on the chucks enables the pieces being made to be put in correct position as quickly. The spindle will be seen to be hollow, which furnishes a convenient means of attaching some of the chucks, although most of them are held by binding bolts in the T-slots. Occasionally, too, there will be a piece of work of such shape as to be held in place by a bolt through the center more easily than by straps or set screws. The hollow spindle is, in fact, like the hollow spindle of a lathe, of everyday utility, and often when least expected.

The diameter of the work is, of course, determined by the position of the carriage, which has to be set for every piece made.



MULTIPLYING INDEX.



CIRCULAR MILLING ATTACHMENT.

The case is different from straight milling, where the piece is put in with the cutter standing free from it. In circular milling the attachment must be moved away from the cutter in order to get the rough piece in place, and after the piece is in, the first feed is to crowd the work against the cutter to the proper depth, when the circular feed is thrown in. In order to keep to a uniform diameter of the work, some means must be adopted to insure that the feed of the work against the cutter shall be stopped at the same point in all cases. This may be done by a stop on the carriage similar to the stop on the turret of a monitor lathe, although I have found better satisfaction with a multiplying index printer, shown in the small sketch. The short vertical arm is engaged by the feed stop, a mark *b* showing when the work has been brought to the required point. This mark is a permanent one on the machine, the pointer being brought to it by adjusting the feed stop. The long pointer so multiplies the movement of the carriage as to enable the setting to be made with accuracy. Where roughing and finishing cuts are made, a chalk mark will show where the pointer should be for the first cut.

Circular milling has no such field as straight milling, inasmuch as the circular attachment has its field disputed by the turret lathe, whereas there is nothing to compete with the milling machine on straight work except the planer and shaper. If there were no turret lathe, and the circular milling rig had only to compete with the common lathe, we might look for a development of circular milling comparable with that of straight milling. The turret lathe, then, puts a sharp limitation on the usefulness of circular milling. Another feature which operates against circular milling is the fact that the overhanging arm and the harness connecting it to the knee cannot be used, as the arm is so low as to interfere with the face plate in many, or perhaps most, jobs. This, of course, makes it impossible to take as heavy cuts as in straight milling, where the arm and harness are used. This difficulty would, of course, be removed if the rig were applied to a machine of the nature of Professor Sweet's traversing machine. With all these limitations, however, there are still plenty of jobs on which the method can be used to advantage, especially in shops where several

milling machines are run by one man. The class of work on which the method is most useful is that requiring shaped cutters, or a gang of cutters, to produce the profile. For example, where the quantity justifies, eccentrics and eccentric straps can be made by this process cheaper than by any other.

There is one little wrinkle shown in the sketches which is of such obvious utility that I call attention to it—not because it is new, but because many do not catch onto it. This feature is the removable blocks *c c*, which drop into the central slot of the milling-machine table. In an outfit of milling machines there will usually be several sizes of slots, and fixtures of whatever kind made for one machine will not go on the others except by happy chance. To overcome this, I make all my milling-machine fixtures with slots instead of tongues, these slots being of the same width on all fixtures. Then I have a pair of steel blocks for each milling machine, the lower end being a fit in the table slot of that machine, while the upper ends of all are a fit in the standard fixture slot. Now, the blocks for any machine may be inserted in any fixture, when that fixture becomes a fit for that machine. In other words, the fixtures may be changed about from machine to machine as may be convenient.

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Handle-Bar Bending.

The handle bar of a bicycle takes a great variety of shapes, from the dignified "plain bend," with its widely separated handles standing at small angles to both the horizon and the line of advance, to the humped-back scorcher's "rams-horn" pattern, in which the "grips" are close together, nearly horizontal, and dropped several inches below the top of the front fork post to which the handle bar is secured.

The handle bar has been in some cases in the season of 1896 made of bent wood, and steamed ash or elm in small diameters is nearly as flexible as new hemp rope, and can be bent into almost any form desired by a skilled wood-bender. By far the greater part of the handle bars are, however, made of thin steel tube, and it is no easy matter to bend this light tube quickly and certainly into handle-bar shapes; the long single-plane curves of the "Columbia Roadster," for example, are comparatively easy to form by a single operation, either in the press or with a double-lever bending trap, bolted to the bench and operated by hand, the two bending levers being pivoted at the centers of the arcs of the handle-bar curves, and carrying accurately shaped grooved bearing rolls to travel along the handle-bar curves as the bending proceeds. The straight tube is put into a vise forming part of the bed-plate of this hand-bending trap, the bending levers being turned way back, so that the unbent bar clamped in the vise lies in front of the grooved rolls carried on the levers, and behind a forming block of the finished bend shape, which is also grooved to fit the tube, and may be of wood, or of wood principally, with cast-iron blocks let in at the hard service points. In some cases I have seen this forming trap made to give curves in two planes at one operation, by making the forming block all cast iron, with the groove carefully shaped to fit the finished bar, and the rolls on the levers journaled to slide on their vertical axes, and guided upward as they are swung round to the front to effect the bending. I was not permitted to photograph this quite interesting handle-bar bending trap, and hence do not particularly describe it; it was very highly esteemed in the shops where it was designed, and was said to be very rapid in action and to produce excellent work. I did not see it in operation, and I very much doubt the value of this unique device as compared with other methods practiced by other shops.

The great difficulty in handle-bar bending is to avoid flattening the tube. No matter how well the roller grooves which bear on the tube are fitted, or how deep they are made, it is very easy indeed to flatten the handle-bar tube in bending, and if once flattened it is quite a tedious operation to restore the lost form. It is common to fill the straight tube before bending, same as copper and brass pipes are filled before making coils or bends, with sand or rosin; if the bend is not too sharp, filling the tube with dry sand and tightly plugging the ends, serves, with suitable bending tools, to quite efficiently prevent flattening of the tube. In the case of the ramshorn bend, however, a mixture of rosin and Trinidad pitch is needful for filling the tubes; the proportions of rosin and pitch should be such as to make the mixture hard enough to break short from a blow, but soft enough to bend under pressure gradually applied. This mixture is melted and poured into the tubes one by one. After bending, the tubes can be properly placed in an oven and many of them heated together, and the filling drained out into a gutter leading back to the pitch melting pot, or into a pan; the pitch and sand fillings can either one be used indefinitely. The sand for tube filling must be very dry.

Fig. 1, from the Lozier shops, Toledo, shows the tools and process of sand filling. The box *A* contains fine dry white sand. Box *B* contains short square pine blocks, a little larger than will completely contain the pipe cross-section; the workman is seated on a bench, with an anvil sitting on the floor in front of him between his feet; unfilled tubes are seen in the box *C*, to the right. The workman first places one of the pine blocks on the anvil, end of the grain up, sets the end of tube on the wooden block, and with a rawhide mallet drives the tube down into the block, which is shaped to fit by the thin bottom edge of the descending metal. Next, a short-nosed funnel is entered in the top of the tube, and the sand is dipped up with a cup and poured into the funnel until it ceases to flow into the tube and the cup of the funnel is filled; then the workman takes a short pine stick and raps the side of the tube gently until the sand ceases to fall in the funnel cup; this rapping is the operation shown in the

Fig. 1. FILLING HANDLE BARS WITH SAND—LOZIER SHOPS.

picture, and it causes the loosely filled tube to take in quite a surprising additional quantity of sand. Finally, the funnel is removed; one of the pine blocks is placed on top of the full tube and driven

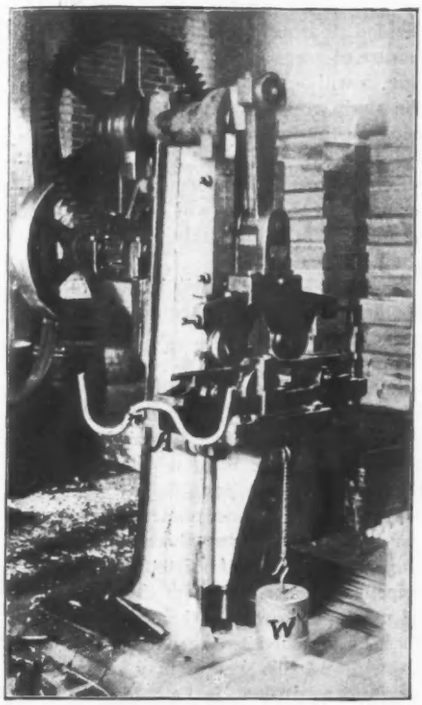

Fig. 2. RUDOLPHI & KRUMMEL'S HANDLE-BAR PRESS—LOZIER SHOP.

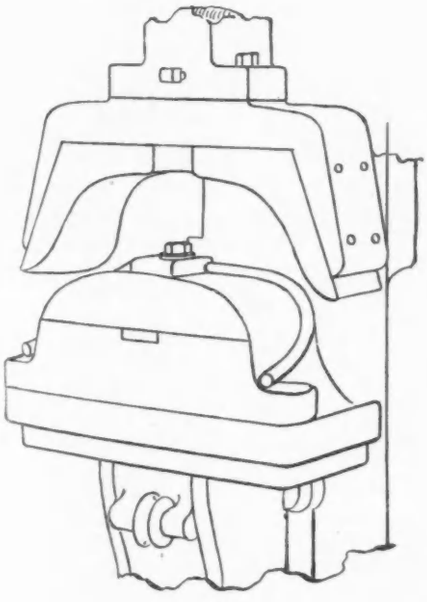

Fig. 3.

half way down with the mallet, still further compressing the sand filling. The tube is then ready for bending in any reasonable curvature.

Fig. 2 shows a Rudolphi & Krummel long-stroke press, fitted with an adjustable knee in place of a solid table, with a set of their handle-bar bending tools in place, and a straight handle-bar blank laid in position ready to bend. This press is a roomy, substantial, powerful tool, with a very long stroke and geared to a slow speed, all of which are essential requisites for the operation of handle-bar bending. The center block of the lower "die" is mounted in a sliding fork, held in position by the weight *w*, which holds the tube in position while forming, lifts it up out of the dies ready for quick removal after forming, and permits that descent of the center block while the forming is in process which gives the offset to the rams-horn shapes. A temper screw stops the downward motion of this center block at a pre-determined position, and thus fixes the angle of the offset, and brings the handle bar to the shape shown in the finished bar hung on the end of the die at *A*, Fig. 2, at the end of the first operation. The completing operation on this bar is shown in Fig. 3, finished. The dies for the operation have wooden facings, secured in a cast-iron shell, reinforced with cast-iron blocks or sheet-metal armor at points of greatest wear. Two operations are needed for forming the rams-horn bar, and two, somewhat similar, are needed to produce the bends for the less abruptly curved styles of bars.

HUGH DOLNAR.

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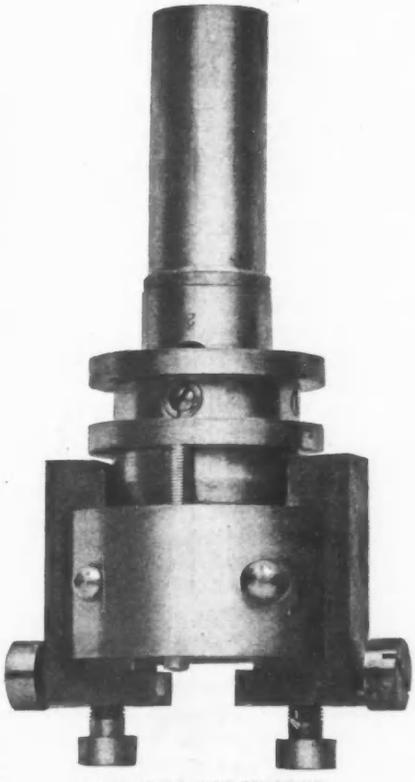
Automatic-Opening Die Head.

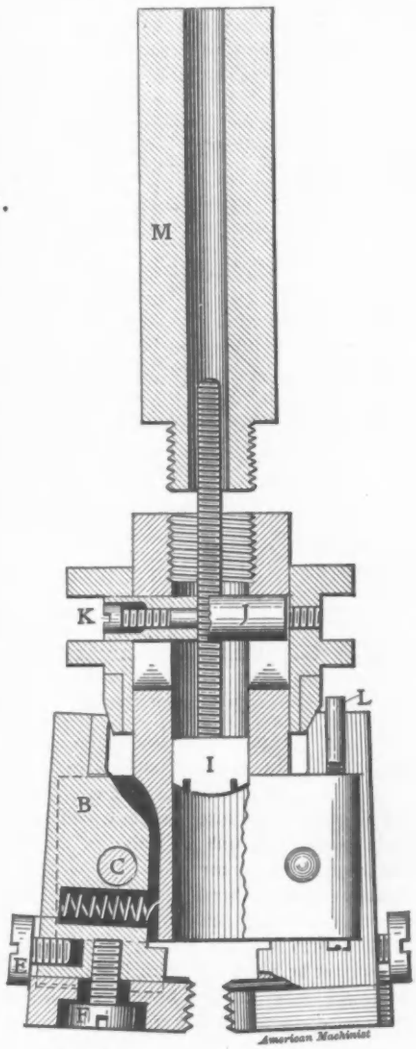
The accompanying engravings show the appearance and construction of the Mischke die holder, which is adapted to be used in the screw machine, drill press



IMPROVED DIE HOLDER.

or other machine capable of giving it or the work the proper rotary motion, and it does not need to be reversed.

The shank *M* may, of course, be made to suit conditions, and upon the body of the tool is a sliding collar which is moved forward by hand to close the dies, but is ordinarily moved to open them by the end of the work striking the screw *I*, which is threaded through the stud *J*, by which the



AUTOMATIC-OPENING DIE HOLDER.

collar is moved. This stud *J* may be readily removed when long work is to be threaded, and the dies are then, of course, opened by hand.

The dies are held at the end of the lever *B*, and are adjustable by the means indicated.

The screw *L* limits the forward movement of the collar, and can be adjusted for small variations in size.

The dies are made to suit circumstances, and there may be two or three of them, according to preference or size of head.

These holders are made in four sizes, to cut threads from ⅛ inch to 1 inch diameter, by the National Chuck Company, 39 Cortlandt street, New York.

ELECTRICAL MACHINERY.

The Sprague Worm-Geared Electric Elevators.

We illustrate this week two pieces of worm gearing which are excellent examples of the manner in which such gearing should be made.

Worm elevators are usually considered as not desirable for high-class passenger service, their usual uses being for freight work or for passenger work in small buildings. The machine shown in Figs. 1 and 2 was designed with a view of making as good an elevator as the worm principle permitted, and, in point of fact, it has been adopted for passenger work in considerable numbers, and in some of the most pretentious buildings in this city.

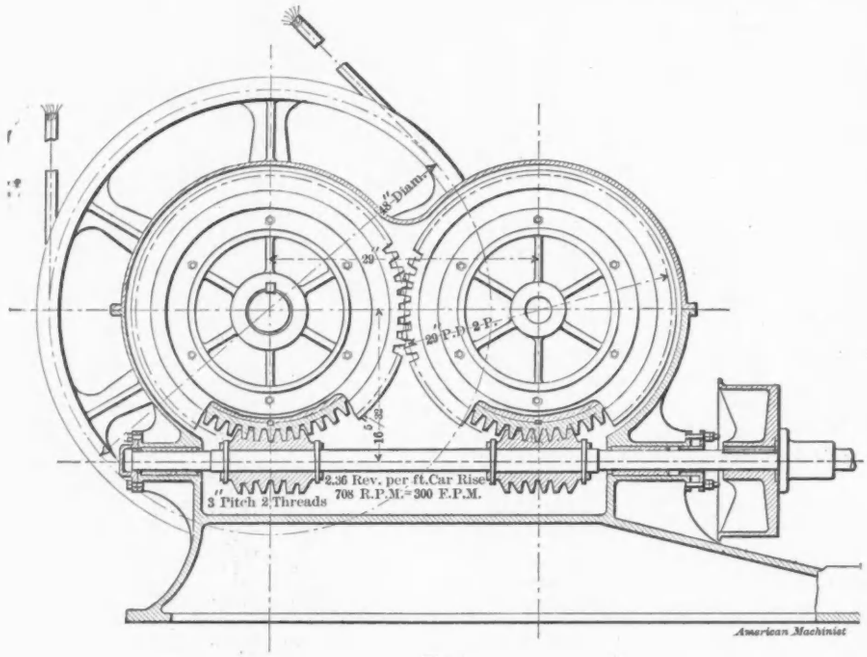


Fig. 1.

The worm is of the Hindley type, so far as contact between the teeth is concerned, although not of the hour-glass shape which is usually given to the Hindley construction. It will be seen that two worms are used, these being balanced against one another, thereby doing away with the end thrust of the shaft, and at the same time reducing the duty on each worm to one-half of what it would be if there were but one. It will be noticed also that the method of connecting these worms is of a superior character, inasmuch as separate spur gears are employed for this purpose. In some cases the worm wheels themselves have been made to mesh together, and so perform the double function of worm wheels and spur gears, and while this construction is, of course, operative, it is clear that the shape of the teeth must be a compromise between that suitable for the spur and that for the worm gear. The provision of separate spur gears enables both spur and worm wheels to be made for their own purpose alone. Moreover, as will be seen from the section taken longitudinally of the drum shaft, the spur gears are in two pairs, one each side of the worm, thereby equalizing the slewing effort on the shaft. The worm wheels will be seen to be simple rings (of bronze) secured between their two spur wheels.

One feature of this gearing would naturally be followed by an expert designer, but it is nevertheless worth pointing out for the benefit of others. It will be noticed that the motor shaft has no collar or other bearing to prevent end motion, but that reliance is placed upon the worms themselves for this purpose. At first sight this looks like a bold piece of work, but a little consideration will show that it is perfectly secure, while at the same time it is a necessity. If our readers have ever cut two spur gears together, and after finishing them have turned one of them half way around on the other, they have found that the teeth did not match, and if those who have not done this will do it when the opportunity arises, they will receive a liberal education regarding the degree of accuracy of index plates and dividing mechanism in general. It is simply not possible to cut a gear by ordinary methods which shall be uniformly divided all around the circle. Taking this feature of gears as they are into consideration, it will be seen that collar bearings on the shaft would involve constant conflict between the two worms, but that by providing a free movement of the shaft endwise, except for the worms, any slight inaccuracy of the gears will be compensated by a corresponding slight end play of the shaft.

Two winding ropes will be seen to leave the drum, one of them being arranged to carry a balance weight. A feature of the drum elevator, which is not shared by other types, is its capacity for having part of the useful load balanced. It is plain that where, as in other types of machine, the balance rope is attached directly to the car, it is not possible to have the weight of the balance exceed that of the car when light, under which arrangement the entire useful load hoisted is done at the expense of energy. With the drum type of machine, however, the balance weight may be attached to the drum, as is here shown, and this weight may exceed that of the car. In fact, if the load on the car were always the same, it could be exactly balanced, and the work could in all cases be done with an expenditure of energy sufficient to overcome the friction. In actual drum machines the counter weight is made to balance the average load, and the energy expended is that required to hoist the difference between the balance weight and the load actually on the car. With a load on the car less than the average, this expenditure of energy takes place when the useful load is being lowered—

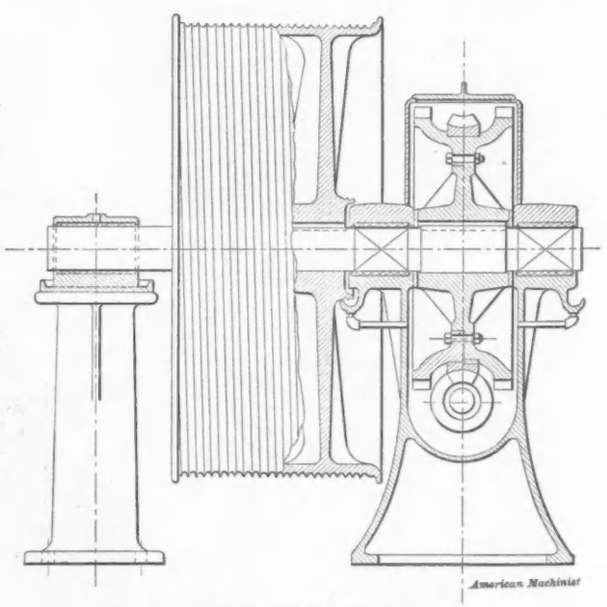


Fig. 2. DOUBLE WORM ELEVATOR.

since in this case the car is overbalanced and the work done is the hoisting of this excess in the counterweight. While, however, this balancing of the average useful load is practiced with drum machines, the disposition of the balance weight is, for constructive reasons, a combination of the two systems. The weight of the car when light is balanced, as with the hydraulic or screw machines, by a weight attached to a rope which is connected directly with the car through sheaves at the top of the elevator shaft. A second counterweight is attached to the balance rope leading from the drum, this weight being made of such size as to balance the average net useful load only. By this means the strains on the drum and its bearings are reduced to the sum of this second balance weight and the useful load, whereas, were the entire balancing done through the drum, it would have to carry strains equal to the sum of the car, the useful load and the entire balance weight.

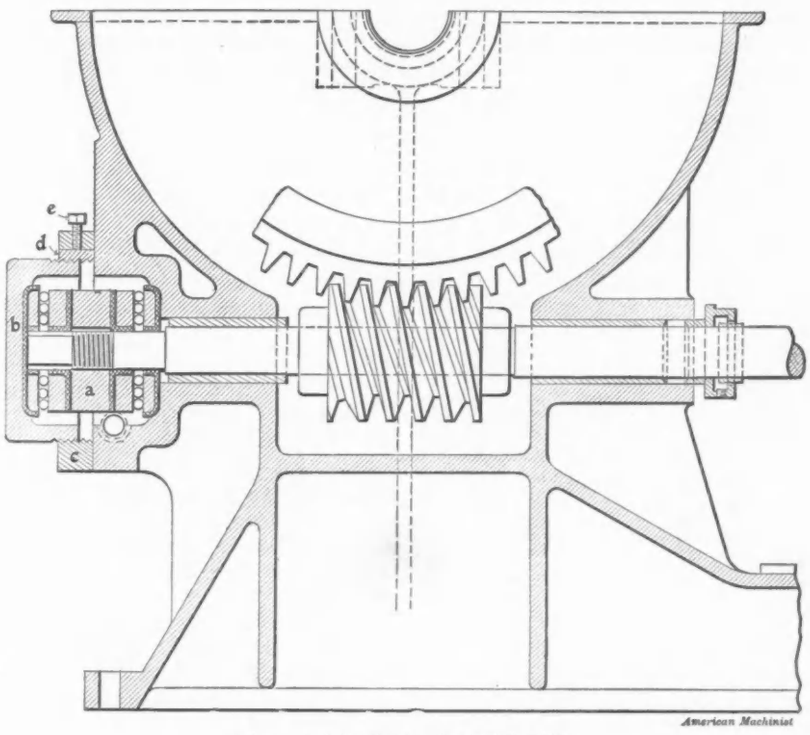


Fig. 3. SINGLE WORM ELEVATOR.

Fig. 3 shows the gearing of a type of machine employed for smaller elevators. In this machine there is but one worm, and the worm shaft is, if necessary, provided with a step bearing. This is a ball-bearing of the same general character as the similar detail of the screw elevator shown in a recent article, except that whereas the previously described bearing was arranged to take thrust in one direction only, this one may take it from either direction. As has been explained, the screw elevator cannot be overbalanced, and the screw is always in tension. With this drum machine, however, the counterweight being equal to the sum of that of the car and the average load, the thrust upon the worm shaft will be in one direction or the other, according as the load on the car is more or less than the average.

It will be seen that this thrust, no matter in which direction it may lie, is taken by one bearing, which bearing is isolated from the oil cellar, and is so located as to be easily accessible without dismantling the machine.

The central disk *a* is both screwed and keyed to the worm shaft, to provide for the thrust and to prevent turning on the shaft. The stationary disks, against which the balls bear, are backed up, one by the frame of the machine, and the other by the screw cap *b*, which is screwed into the flange *c*. The screw connection between cap and flange provides for adjustment, while the bolted flange joint provides for opening up the bearing without disturbing the adjustment. The turning of the cap in the flange is prevented by a small brass block *d* let into the flange and backed up by a set screw *e*.

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What Is Electricity?

A recently published book of three hundred pages, devoted to the answering of the above question, accomplishes only the following as the final results:

"We have already strong grounds for believing that we live in a medium which conveys to-and-fro, or periodic, movements to us from the sun, and that these movements are electromagnetic, and that all the transformations of light and heat, and indeed the phenomena of life, are due to the electrical energy which comes to us across the vacuum which exists between us and the sun—a vacuum which is pervaded by the ether, and which is a fit medium for the transmission of the electromagnetic waves."

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The movement of trains through the Belt Line tunnel in Baltimore is, of course, very irregular, with long intervals when no power whatever is used. To meet this condition the boilers are supplied with blowers instead of smokestacks. A low smouldering fire is maintained under the boilers, and the machinery is kept at a standstill except when trains are being moved. The approach of each train is telegraphed to the power house, when the blowers are speeded up and steam is soon generated at a rate sufficient for the moving of the train by the electric locomotive.

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The Union Traction Company, of Philadelphia, has just made the most important installation of the storage battery for traction purposes in the United States. The battery is placed at the end of a feeder eleven miles long, and is used to equalize the demand on the feeders and to send a current down a new extension of the system. The battery was found to provide for the extension more cheaply than a new power house or enlarged feeder wires.

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The use of the incandescent lamp for street lighting is extending. The most important plant of this kind so far undertaken will shortly be installed at St. Louis. There is no doubt that, except where really brilliant street lighting is attempted, better distribution and a more satisfactory general result can be obtained with incandescent than with arc lamps, but it has taken a long time to learn the fact.

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Mechanical stokers have come to be a very common feature of electric power houses in the East, but in the West they are not successful. This difference in results lies in the coal used. The stokers work with anthracite coal, but with soft coal the formation of clinkers on the grate bars is so serious an evil as to offset any advantages they may have.

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Electric street railway authorities officially recognize the serious competition of the bicycle which has arisen in many localities. It is believed, however, that inasmuch as it promotes the habit of locomotion, its effect in the end will be favorable rather than otherwise.

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Since the removal of the statutory limit of $5,000 damages in case of death by railroad or other accidents in New York, verdicts of $20,000 are not uncommon.

Letters from Practical Men.

A Simple Eye Remedy.

Editor American Machinist:

Reading your article, "Machine Shop Oculists," leads me to think the following may be of use to the sufferer from an inflamed eye, resulting from various causes. Of course, any foreign substance must be got rid of before any cure can be effected, by the usual means, as set forth in your article:

Make a small sack or bag, oval or circular, from a piece of clean old white cotton about two inches diameter; fasten to each side a piece of tape long enough to reach, and tie around the head—for two eyes it would appear something like a big pair of spectacles. Get some fresh clay, thoroughly dry it, then pulverize it, fill the sack full and close the opening. When ready for bed, thoroughly dampen the bag of clay with vinegar, and apply over the troubled optic; fasten securely to the head with the tape strings, pressing the dampened mass thoroughly against the face and eye. In the morning you will have a cast of that part of your face, in which your trouble will have disappeared. My friend the doctor kept me away from work several days under his best treatment. A tramp told me of the above, and one night settled the trouble. I believe it is the cheapest and best remedy known, and cannot injure any one.

JONATHAN DAVID.

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False Assumptions.

Editor American Machinist:

If we are going to work to think something out we can't be too careful about our premises. We can, of course, go from any place in the world to any other place in the world, but we are much more likely to get there, and will certainly get there sooner, if we start on the right road. Many men never get out of the wilderness into which a wrong start has led them. This experience is as common in the mechanical world as in any other. Some have started out believing in the omnipotence of mechanical contrivances and have evermore chased perpetual motion fallacies. It is to be supposed that Archimedes generally knew what he was talking about, but he was giving a wrong impression to many who have lived since his day, when he was running around and bragging about how he could lift the earth, if he only had a place for the fulcrum of his lever. Supposing that he had his fulcrum, and his lever all rigged up to the best advantage, and that he had tugged at the long end of the lever ten hours a day for forty years, not working Sundays or holidays, I calculate that at the end of his life he would have moved the earth, omitting decimals, about one-half of a trillionth of an inch. Why, he would have required a compound-condensing or a triple-expansion micrometer to have found out whether his life work had moved the old thing at all or not.

The false and misleading assumptions as to mechanical principles and requirements are sometimes big ones and sometimes little, but they all lead astray. When it is assumed that power is lost by the use of the crank, that we may call a big one, and it is no wonder that "inventors" have been led by it to spend much time in devising ways and means of circumvention. The hinge belt lacing that we see going the rounds of the papers occasionally is made upon a small false assumption. There is no more bending required at the joint of a belt when passing over a pulley than at any other point of the same belt, and any mode of belt lacing known to man always leaves the belt freer to bend at the joint than elsewhere, so that the ingenious hinge belt lacing is not as good as one without the hinge principle, because it is not as strong, and will not last as long as the fastenings that are not "hinges."

Some years ago I was connected with a concern that did a big business in pulleys and shafting, and we put in a pulley-grinding machine. For pulleys up to a foot in diameter or so we found that we could grind them considerably faster than we could turn them. The emery wheel cut free and fast and, of course, made lots of dust, so that an essential part of the machine was an exhaust fan with about a 4-inch discharge pipe. The fan would take away the dust quite effectively, but then we were in trouble about what to do with the blast and the dust that it carried. That matter was very quickly disposed of—temporarily. It happened that the pulley-grinding room was located quite near the boiler chimney, and it was the simplest thing in the world to just turn the blast into the chimney. That blast was turned into the chimney under a decidedly false assumption, and we found it out in a week or two. The works were located in the midst of a populous neighborhood, and the first washing day the clothes in the yards on the lee side of the chimney were badly spotted with iron rust. The second washing day enabled the good women to formulate the correct assumption that the iron rust was caused by the iron works, and the blast from the emery wheel was taken out of that chimney quite suddenly.

That did not end the matter, as we still had that blast to dispose of. The false assumption was then started that the reason why the dust was carried up and out of the chimney was that it really had no place upon which to settle in the chimney; so then a vertical wooden shaft was made, Fig. 1, not as large in area as the chimney, and extending up to the roof of the four-story building, and with partitions every two or three feet, the partitions extending across perhaps three-quarters of the area, but with the successive openings upon opposite sides. The air then had to take a zigzag course from side to side all the way up, and as it passed each shaft it was in duty bound to deposit some of its dust upon it. It did deposit some, but it passed the openings at considerable speed, and was all the while stirred up, and when it got out it still carried lots of iron dust.

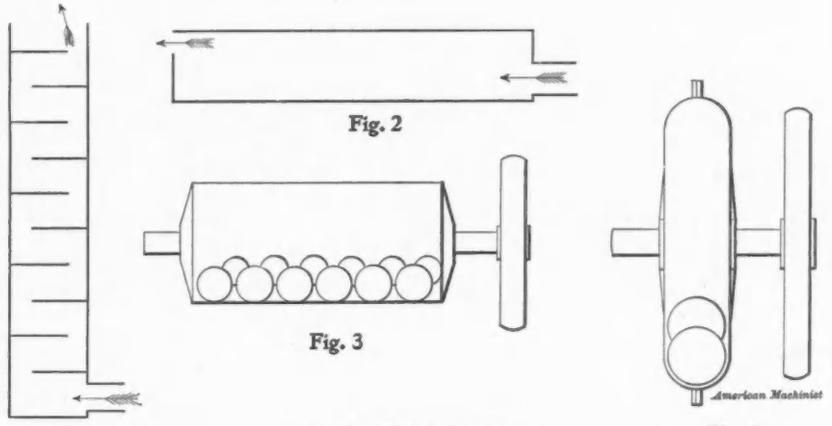

Fig. 1 Fig. 2 Fig. 3 Fig. 4

FALSE ASSUMPTIONS.

So that did not work. If water carries mud, or if air carries dust, they are going to carry a lot of it as long as they are flowing fast, but when they get into a place where they can spread out and move along leisurely they will make their deposits. The final arrangement for disposing of the dust was a perfectly simple and common-sense one; only, of course, the common sense came last, as usual. The blast was discharged into one end of a horizontal box, Fig. 2, about three feet square and, say, fifty feet long. There was an opening at the upper corner of the further end of the box, about a foot square, and the air came out of there almost perfectly free from dust. It was only necessary to have some openings in the side of the box and shovel out the dust deposited, which we did by the barrelful.

Everyone knows the blacking mill used for pulverizing coal for molders to use in the blacking bag to dust their molds with. It is just a tight horizontal cylinder mounted on two trunnions, with a pulley to drive it, not very fast, and a lot of iron balls inside. The balls keep rolling over

the coal and they crush it very fine, the secret of their successful operation being that their whole weight bears only on a point or a very small surface at a time. Probably no more effective pulverizer is known to this day, but it takes quite a lot of time to do the work. I knew a man who got up an "improved" pulverizer that, upon his false assumption, was to do the work much faster than the old style, but it simply refused to do it at all. You can catch the idea from Fig. 4. He made a circular chamber with a semi-circular section at the periphery, and he used two or three balls that were only a little smaller in diameter than the semi-circular shape of the shell, so that when the material to be ground was in the mill the ball would not bear just on a point as in the cylindrical mill, but would bear nearly half way round the ball. Although the balls have always done their work well in the cylindrical mill they positively refused to grind in the new contrivance.

We may go on assuming that a thing ought to work as long as we choose, but if it will not work it will take something more than our assumptions to make it go.

TECUMSEH SWIFT.

▲ ▲ ▲

Self-Skimming Ladles — A Cheap Dry-Out Furnace—Heavy Planing—Laying Out a Sprocket Wheel.

Editor American Machinist:

It seems strange that anyone who has ever had practice in using a self-skimming ladle on small work should care to go back to the old style of skimming with a crooked iron. The self-skimming ladles referred to here have a simple piece of metal placed across about an inch or two from the pouring lip. The act of tipping up the ladle to pour causes the metal to rise and flow under the skimming bar, effectually preventing any slag or scum from passing into the mold. These ladles cost but little more than the old-fashioned pots, and the services of a skimmer are entirely dispensed with.

A very cheap dry-out furnace for ladles of this and other kinds was noticed the other day. It was built entirely of grate bars. Two heavy bars were laid upon the ground; some short pieces of bar were placed across, cob-house fashion, and another heavy bar laid on top of the short pieces. A similar pile of bars was erected two or three feet distant, and across both of the top bars some grates were laid right side up, and upon this grate surface the fire was built which was to dry out the ladles. This grate was bound together by other grate bars cut about two feet long and placed across the ends of the bars, acting as a fire grate. A single long bar placed parallel to the grate bars, resting upon the short end pieces, was next placed in position on top of all, and formed an excellent rest upon which the ladles were placed, upside down of course, to dry out over the fire which was built upon the grate surface below. The whole business was just high enough so that when a ladle was placed upon the top grate bar, the handle of the ladle would rest upon the ground, the ladle itself standing with its opening in a horizontal position. A fire of wood mixed with a little coke was burning upon the grate, and ten or fifteen ladles in various stages of dryness were placed upon the upper grate bars. It was a handy little scheme, one of those things which cost nothing, and that set people to wondering why they have not been built before.

A heavy job of planing was recently done in the shops of Brown & Miller, Jersey City, which would make the builders of heavy machine tools turn green with envy and disgust. The job was the planing of some immense salt vacuum pans. It may not be known to all machinists that salt is now made by being boiled in vacuum in a manner similar to that used for making sugar; by partially exhausting the air of a vacuum pan, water will boil freely when heated to a comparatively low temperature by steam coils. These pans were six or eight feet in height and sixteen or eighteen feet in diameter. Each pan was made up of several segments, and the planing of these segments so as to fit together required a pretty large tool.

The way it was done was to strip off the fittings from a plate planer in the boiler shop; a heavy erecting plate had its top surfaces planed very true, and the plate was then bedded in the ground in front of the planer. After the plate was accurately leveled and lined up to the planer, it was set in place by running a little cement around it. A heavy casting was then bolted to the edge planer; the saddle taken off a planer in the shop, and bolted to this upright casting. This provided the necessary up-and-down movement for the tool. The work was clamped to the erecting plate after being properly laid out and moved into position.

Upon starting up the edge planer, the tool made fast to the casting above mentioned, traveled back and forth over the edge of that vacuum pan segment in a manner exceedingly lively and business-like, and the work turned out was as good as the writer ever saw done in a machine shop. After one edge was planed, the exact angle and size of a section were struck out on the erecting plate, and the segment moved up and bolted so that the finished lines corresponded with those of the plate. While in this position the remaining side was planed, and when the several segments were assembled in position I could not tell where any error existed. There seemed to be none in the fit of the pieces.

The drilling of the sides and the top and bottom was made accurate by another rig. The sections were moved up to a hydraulic riveter and a radial arm bolted to the top of the riveter frame. It so happened that the top of this arm came about level with the top of each segment. A power-driven portable drill was then bolted to the radial arm, and after the holes had been laid out at the required distance apart, this arm permitted the drill to be swung from one hole to another, and kept them at equal distance from the center of the pan.

Some time since, considerable discussion was provoked by a method given for laying out a sprocket wheel. In the discussion referred to it seems that bicycle wheels were about the only kind treated; but the manner in which a sprocket wheel for a link belt was designed off-hand, and the drawings, pattern and casting made in less than two hours, might prove of interest.

A sprocket wheel of six teeth was required for No. 33 chain. A telephone message to the dealer brought the cheering reply that it would require ten days to get a wheel made. The nearest approach was a wheel of 26 teeth which happened to be on hand. A sheet-lead template was cut and fitted to one tooth and the space between two teeth. Reference to a catalog of sprocket wheels gave the pitch diameter of the new wheel, which was laid out on paper; then the pitch line was cut into six equal parts by the use of the 30 and 60 degree triangle.

The lead template, with pitch line marked upon it, was then placed upon the drawing laid out as above, and the outline of the tooth marked with a sharp-pointed pencil. All six of the teeth were marked in this manner; then the other portion of the template, representing the space between two teeth, was applied to the marks already made, and a position found where it would be tangent to both tooth sections at the same time, while the pitch lines coincided. This position found, the teeth were connected by drawing a pencil along under the template. The total time of designing the gear as above occupied about ten minutes.

While this was progressing, the pattern maker had been instructed to turn up a blank to the shape of a sprocket gear having a pitch line of a certain diameter. A single section, consisting of one tooth and one space, was cut out of the drawing, and the gear laid out in pencil by marking along the pattern thus drawn. The teeth were then cut out on the band saw and the pattern filed up and shellacked in fifteen minutes more.

A quick trip to the foundry and the patterns were in the sand and the castings out, all in less than two hours from the time of starting. While this gear may not have been theoretically correct, it was found to run as smoothly as any gear in the factory. The teeth seemed to be the right distance apart and of the right size.

JAMES F. HOBART.

That Thread Tool.

Editor American Machinist:

In your issue of September 17th I notice the remarks of Mr. Fulton in regard to tool shown in your paper of September 10th. I think that perhaps it would not have struck Mr. Fulton so if he had known the peculiar work of the tool, or the speed of the lathe.

If, in our experience, we had found that the tool would remove more stock in a given time by grinding it differently, we probably would have done so before this time.

The facts are as follows: The tool shown is a "thread tool," and we believe that most thread tools are ground flat on top. Second, we run the lathe only 4 revolutions a minute, making the fastest surface speed little over 4 feet per minute.

Notwithstanding the bad shape of the tool, etc., we cut a thread 17 feet long on a bar 4 1-16 inches diameter, removing 841 cubic inches of steel in 20 hours.

H. R. M. GREGOR.

Bloomfield, N. J.

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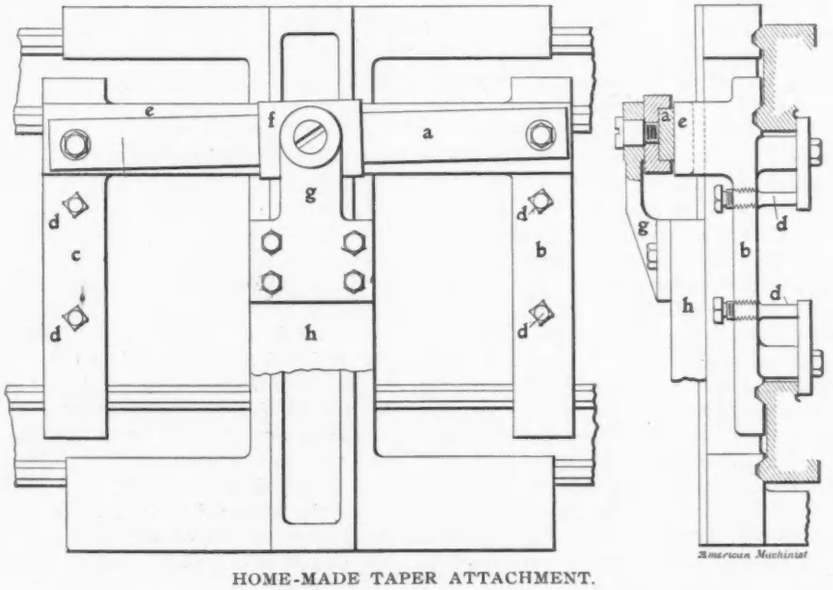
Home-Made Taper Attachment.

The driving screw of the Sprague-Pratt electric elevator is connected to the motor shaft, of which it forms a prolongation, by a taper socket in one with the motor shaft, the screw entering it by a taper fit and being held in position by a key. The screw is of various lengths in different machines, and the taper is consequently located at various points in the lathe with different screws.



HOME-MADE TAPER ATTACHMENT.

Our accompanying illustration shows a home-made taper attachment which was fitted to a plain lathe for this job, and which is found to perform its functions in an entirely satisfactory manner. The tapered portion of the screw is always of the same taper and length. The attachment consequently has no adjustment for different tapers, though it easily might have. The length of taper which can be turned by the rig is somewhat less than the range of the usual construction, as will be seen, though it is sufficient for the job, or for most such jobs, and could if necessary be increased.

There being no planed seat on the back of the shears, the guide bar *a* is carried by two bridges *b*, *c* which rest upon the inside V's and are held in position by the binding screws *d*. The two bridges are cast in one piece, being connected by the tie bar *e*, which is planed upon its top surface and forms the seat of the guide bar *a*. It will be seen that this tie bar *e* goes over the cross-girt of the lathe carriage, and that the length of travel of the lathe carriage and of the taper which can be made is limited to the movement of the cross-girt between the bridges. In the present case this distance is, however, about 14 inches, giving all the range needful for most jobs.

The connection between the guide-bar slide block *f* and the tool post is through the tie piece *g*. The lathe has a compound rest, and this tie piece *g* is bolted to the lower slide *h* of this rest. The lower cross-feed screw is, of course, disconnected when the taper attachment is in use, and the upper screw of the compound rest is used for adjusting the tool.

The attachment being bolted to the V's of the shears, it can be used at any point in the length of the lathe equally as well as though it had originally been furnished with the lathe. The connection between the guide bar and tool slide will be seen to be unusually solid and substantial—much more so, in fact, than in some designs which come from the lathe builders.

A NOVEL EXPANDING MANDREL.

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A New Expanding Mandrel.

The half-tone herewith illustrates a novel expanding mandrel, the invention of Mr. J. O. Smith, of the Goss Printing Press Company, N. Y. The one actually represented was made for expanding into and holding the iron pipe upon which rolls of paper are now furnished for the large newspaper presses. For this use it is, of course, not essential that the pipe should run absolutely true. One of these mandrels is fastened by the set screw to one end of the shaft, the end of the pipe with its roll of paper is placed upon it and shoved up against the shoulder, this movement tightening the jaws in that end of the pipe; then the other is inserted in the other end of the pipe, and the central part or expander is pushed or driven in, distending the jaws until the tube is held tight and central, when the set screw in the hub of the expander is tightened and the roll is held securely.

The three expanding pieces or jaws

have dovetailed grooves which fit easily upon dovetail strips cast on the central expander, and after these pieces are slipped on, the little screws are inserted and prevent their being slipped entirely

Fig. 1. SHAVINGS.

off again. Horns upon each piece project over into notches in the next, so that the three jaws are always kept opposite each other. This expanding mandrel, which, by the way, appears in the Patent Office Gazette as an "expansible chuck," cannot, of course, be recommended for absolutely true work, and was not intended primarily for machine-shop use at all; but for facing pipes and for similar purposes it might be easily preferable to something more pretentious.

▲ ▲ ▲

Steel Wool.

We feel that we will be doing a service to some at least of our readers in calling their attention to the steel wool, some samples of which are shown in the accompanying half-tones. The name of the material is not inapt. The finest grades of it are very suggestive of black or dark-gray wool in appearance, and it feels quite like

Fig. 4. STEEL WOOL.

wool to the touch. It is also surprisingly light, as may be judged from the bulk of the packages, a one-pound package being over three inches in diameter and, say, fifteen inches long. Seven grades or sizes are furnished by the manufacturers, the four coarsest of which are called shavings, and the three finer grades, steel wool. The material is really composed of continuous, fine, flat steel shavings, and its profitable production is one of the modern mechanical wonders. It is made only in Germany, and the list price in the United States is 75 cents per pound for the finest wool and 40 cents for the coarsest shaving, with, according to modern methods of business, unmentionable discounts.

The steel wool is chiefly of interest to the machinist as a mechanical product. Its principal use is as a substitute for sandpaper, especially for the finer and more delicate finishing of surfaces. It is used quite extensively by cabinet and furniture makers and polishers, and should be of value to pattern makers. It is used by painters, carvers and yacht builders. The hulls of the "Defender," "Valkyrie," "Vigilant" and other yachts were given their last scouring with it when dry-docked before racing. It does not scratch or clog with paint or varnish. It may be used for polishing brass or other metals,

Fig. 3. SHAVINGS.

and the coarser shavings are good for removing paint, rust or scale from iron or steel surfaces. It is being introduced here by Aquila Rich & Co., 180 Cherry street, New York.

▲ ▲ ▲

Bevel-Gear Curves.

In spite of an amount of care which ought to have prevented it, an engraver's error crept into the engraving accompanying Mr. Alden's article, which appeared in our issue of October 8th, and, consequently, we repeat the diagram on the next page, properly corrected. "Nothing is so easy as it seems, except making mistakes."

▲ ▲ ▲

A friend sends us a clipping from the "New York Times," which reads as follows: "A machine of great value to power lessees and power lessors has been invented by a German engineer. It is called a dynamometer, is easily handled, and by its use the consumption of power, at any time, can be checked off in a most precise manner. The inventor has one of the machines attached to his desk, and by means of it ascertains the difference in the amount of coal used before and after cleaning the boilers." Engineers will be much interested in knowing that there is such a thing

Fig. 2. SHAVINGS.

as a dynamometer, and especially that it will indicate the difference in coal consumption due to boiler-cleaning.

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The Chicago house of Hill, Clarke & Co. had a slight fire a short time ago which was attended with some peculiar features. The fire was confined to the platform and runway, where there was no machinery, and none of the tools in stock was actually touched by fire or water, and yet there was a loss resulting from the fire, which was caused by the breaking of windows by the firemen, thus allowing the store to be filled with damp atmosphere which condensed upon the machinery and rusted it somewhat. It is said that the insurance companies had never adjusted a similar loss before.

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Our contributor, J. L. Lucas, has left the employ of the General Electric Company, at Lynn., Mass., where he has been

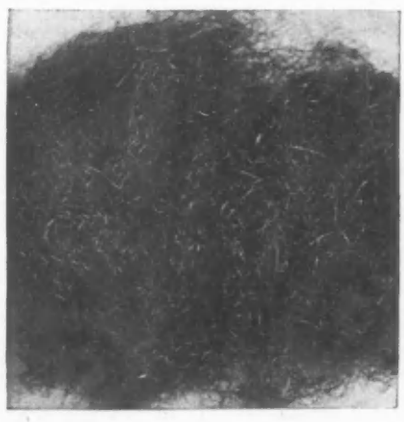


Fig. 5. STEEL WOOL.

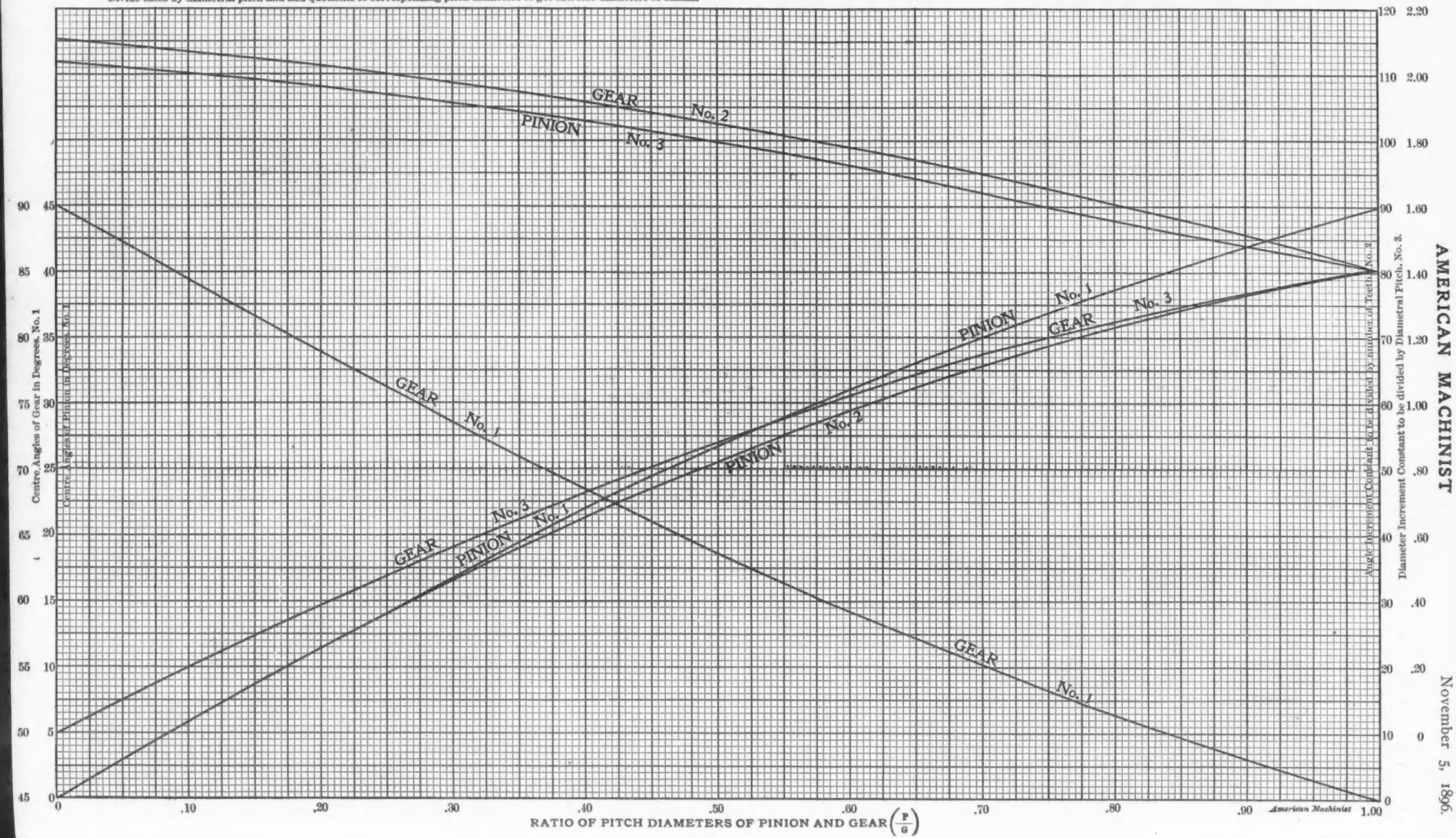
the past nine years as foreman of the press and die department, and is now with the Mossberg & Granville Manufacturing Company, Providence, R. I., as designer on die work and salesman.

BEVEL GEAR CURVES.

PLOTTED FROM GRANT'S BEVEL GEAR CHART BY H. W. ALDEN.

Instructions:

TO FIND CENTER ANGLES, CURVES No. 1 Divide pitch diameter (or number of teeth) of pinion by that of gear and over corresponding ratio on base line find center angles of pinion and gear on their respective curves.
TO FIND ANGLE INCREMENTS, CURVES No. 2 Divide pitch diameter (or number of teeth) of pinion by that of gear and over corresponding ratio on base line find angle increment constants for pinion and gear on their respective curves; Divide these by number of teeth in corresponding gear and add quotients to center angles to get FACE ANGLES of blanks. Multiply the above quotients by 1.1667 and subtract product from center angles to get CUT ANGLES of gears.
TO FIND DIAMETER INCREMENTS, CURVES No.3 Divide pitch diameter (or number of teeth) of pinion by that of gear and over corresponding ratio on base line find diameter increment constant for pinion and gear on their respective curves; Divide these by diametral pitch and add quotients to corresponding pitch diameters to get extreme diameters of blanks.


GEAR No. 2
PINION No. 3
GEAR No. 1
PINION No. 1
GEAR No. 3
PINION No. 2
GEAR No. 1
PINION No. 3
GEAR No. 3
PINION No. 1
Centre Angles of Gear in Degrees, No. 1
Centre Angles of Pinion in Degrees, No. 1
Angle Increment Constant to be divided by number of Teeth, No. 2
Diameter Increment Constant to be divided by Diametral Pitch, No. 3.
RATIO OF PITCH DIAMETERS OF PINION AND GEAR (P/G)
American Machinist

AMERICAN MACHINIST
November 5, 1896.

British Frankness.

We clip the following from an editorial on "The Migration of Trade," which we find in London "Engineering" for September 25th. The editorial in question is brought out by and devoted to the proposed removal of Yarrow & Co.'s torpedo boat works to the European Continent.

We are not of those who believe England to be industrially on her last legs, or even on the decline, and we do not quote this extract with a view of upholding that jingo notion. Our object is to lay before our readers an instance of what we see almost daily in our English exchanges, namely, the habit of speaking out in meeting, which is in the sharpest possible contrast to the spread-eagle jingoism of some of our own newspapers. We are satisfied that if our papers would devote a tenth of the space to pointing out our deficiencies that they do to extolling our points of superiority, it would conduce far more to the progress of the country.

The spread-eagle spirit in these matters is especially unfortunate for us, because there is nothing to counteract it. The proximity of European nations to one another makes it impossible for one to be ignorant of the progress of others, but in our case we stand isolated by the Atlantic ocean from any other manufacturing nation of importance, and we have comparatively few direct means of knowing what others are doing. This isolation has been our salvation in a political sense, but it works heavily against us industrially. That these natural disadvantages should be magnified, and a spirit of self-satisfied ignorance encouraged by the contemptible spirit of jingoism, is, in our opinion, deplorable. In the struggle for the markets of the world on which we are obviously entering, the last thing which we can afford is to underrate the strength of our antagonists or to remain in ignorance of their resources. They will serve their country best who point out facts—especially unpleasant ones. It is the sick man who needs medicine; those who are well derive no benefit from being complimented on their robust appearance; and so what we need is to be told our deficiencies, for on those points on which we excel matters can be trusted to take care of themselves. We extract as follows:

"Mr. Yarrow's project is full of instruction to all classes of people, but to appreciate it to the full it is necessary to know him. Mr. Yarrow has been the architect of his own fortunes, and there is no part of his business, from the smallest mechanical detail to negotiations with foreign Powers, which he is not capable of personally undertaking. He knows exactly what he would abandon in leaving the country, and although he cannot be so fully acquainted with the conditions he would go to meet, yet he has had ample opportunities of studying them. The experiment would be watched alike by manufacturers and workmen, and it is to be hoped that its lessons would be laid to heart. If he should be successful it does not follow that this country is played out, but it does show that we are entering on a new era and that new methods must be adopted. We still have natural advantages which no other country possesses, but these are more or less balanced by our conservatism and ignorance. Many of us imagine that our commercial supremacy is in the order of nature and Providence, and that it cannot be upset, notwithstanding that we see other nations attacking it first at one point and then at another. British consular agents are ever reiterating that we are imperilling our markets by our want of consideration of the wants of our customers, and that unless we change our methods, the superior tact and pliability of our rivals will succeed in supplanting us. From all parts of the world we hear this warning, and yet it takes very little effect. We go on in our old ways, and the danger is that we shall do so too long. The time to inaugurate changes is when we are prosperous. It will be impossible to do so when our capital is diminished and we are in difficulties. All new departures are expensive, and it is only people with resources that can make them. It is natural enough to defer them until the pinch is felt; but it is not wise. As Abraham Lincoln said, 'It is dangerous to swap horses crossing a stream.'"

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English and Australian Students of Our Railway System.

We referred recently to the visit to this country of the Russian Minister of Railways, and since then two other foreign railroad men who have been here studying our railway systems have expressed their views. Mr. Harry Pollitt, Chief Engineer of the Manchester, Sheffield & Lincolnshire Railroad Company, of England, has been in this country about two months on a tour of inspection and recently returned to his own country. A feature of our railroad systems which seemed to impress him most strongly, perhaps, was the vastness of our systems as compared with those of England, our greater distances compelling, in a sense, the doing of things on a larger scale. Our railway managers, he thought, had also developed the habit and plans of arriving at results with short cuts which are not allowable or at least available in English practice.

He spoke of the Pennsylvania Railroad and the New York Central as being far superior to any others in this country, and thought they had closely copied English methods, and in some instances improved upon them.

A point which he commented upon particularly was the apparent superior intelligence of railway employés in this country, and he spoke especially of the superior intelligence of American conductors, engineers and other trainmen, which resulted in throwing more responsibility upon such men in this country and enabled managers to reach results with celerity and safety, by methods which would not be possible on English railroads, the efforts of managers there being necessarily attended with greater care and more red tape.

Mr, Pollitt thought England was ahead in the matter of block systems and other mechanical devices for securing safety in railroading, and no doubt he is right on this point.

He thought that the development of American locomotives had been surprising, but claimed that in finish and durability the English engines were the superior machines, and called attention to the fact that English locomotive builders are restricted to a hight nearly two feet less than is allowable in American practice, and that the maximum width of English engines must also be considerably less, and this, of course, restricts the power which can be developed.

He commended our large terminal railway stations as being very well adapted, but said that the way stations are poor affairs and would not satisfy the requirements of the British public.

The other visitor to whom we refer is Lieut. Col. Henry C. Stanley, Member of the Institute of Civil Engineers and Chief Engineer of the railways for Queensland, Australia. His visit to America was made in the interest of the Colonial Government, and it is thought from opinions expressed by him that one result of his visit will be the increased use of or adaptation of American ideas on Australian railways.

Mr. Stanley states that Australia is on the eve of a period of railway extension and improvement, and that one of the first important things which may receive attention will be the unification of railway gages, there being at present no uniformity in this respect in his country. In Queensland the gage is 3 feet 6 inches, in New South Wales the gage is the same as our standard—4 feet 8½ inches, in Victoria it is 5 feet 3 inches, and there are two gages in South Australia, one 5 feet 3 inches and the other 3 feet 6 inches. This, of course, is an obstruction to traffic, and requires changes of cars by passengers and transfer where there ought to be no necessity for them.

The railways of Australia are owned by the Government, and Mr. Stanley expressed himself in unreserved approval of this plan of operating railroads, saying that the service was under civil service rules, and that it worked well in the interest of the people in every way.

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When this reaches our readers the Election will be over. We hope and believe that the decision will be right; but in any event we must abide by the result and make the best of it.

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The Way Some Patents Work.

How the inventor often fares when it comes to a question of infringement is graphically told in a recently published interview with Henry Burk, a man interested in a proposed morocco leather trust. Referring to a patent on the process, he said:

"The patent was secured by Augustus Schultz. He was a poor man, and all the tanners began using his discovery without paying him for it. Then, before we realized it, F. Blumenthal & Co., of New York, stepped in and bought the patent. They began damage suits against the rest of the tanners for infringement. It was different then. Blumenthal & Co. are a rich firm, and we could not afford to fight them. Schultz was poor and did not count. But when Blumenthal & Co. said, 'You pay up,' we began to think. Foerderer & Co. were the chief infringers, and would have been subject to immense back damages. To prevent this, Foerderer stepped in and bought the patent * * * and asked if we did not want to come in with him. * * * Our lawyers told us we were beaten at the start if we tried to fight, so we decided to join with Foerderer. Now there are five firms interested in the ownership of the patent."

Of course, there is in this nothing new to those who have had opportunities of observing things connected with patents and their practical workings; but such statements are usually confined to the inventors who suffer by this condition of affairs, and we do not remember to have seen before such a frank statement by one who was profiting by the operation.

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Naval Courts of Inquiry.

Those who know anything of how naval courts of inquiry are constituted will not, of course, be surprised at the findings of the court which investigated the grounding of the "Texas."

According to the decision of the court, everybody in the engine room with any responsibility whatever was to blame, and nobody on deck (where, according to the line clique, all responsibility really rests) was in any way responsible.

The facts (as nearly as a mere landsman can get at them) seem to be that the "Texas" was in pretty shallow water, and stood a tolerably good chance of grounding no matter how promptly the engines might have been reversed. At a critical moment the electric lights went out (the lighting apparatus is in charge of the line, because the lanterns and tallow candles of former days were); the men in the engine room were naturally rushing about trying to get lamps started, which seems to have been the pre-eminently proper thing to do, and in the darkness and confusion the Machinist who had charge of the engines did not get them reversed as promptly as would otherwise have been possible, perhaps. He is sentenced to be reprimanded, as is also the Chief Engineer; and, not satisfied with this, the court demanded that the Engineer be court-martialed, though this part of the findings was not approved by the Secretary of the Navy, probably because its absurdity was thought to be too palpable.

The Engineer is blamed for not being in a position where he could see that both engines were working properly. Of course, we all know that he might just as reasonably be blamed for not being in a position to see that all the boilers were working properly, and if anything had happened in the boiler room he probably would have been, the fact being that it is an absurdity to attempt to specify just what particular position the Chief Engineer of a naval vessel ought to be found in at any particular moment.

The Commander of the Fleet, Admiral Bunce, appointed the court, and it is well known that he thinks the engineers are little better than a necessary evil, and that they have too easy times. In fact, it is said that, previous to taking command of the fleet, he said as much, and that he would "make it hot for them." It goes without saying that a court so constituted is a mere mockery of justice.

In this connection it becomes pertinent to inquire why there was no court of inquiry to determine the cause of the trouble aboard the "Indiana," to which trouble we have previously referred. It will be remembered that serious difficulty was encountered during rough weather by the turret becoming loosened. When it was seen that the locking device was under excessive strain, why were the guns not lashed to the deck at once? and were the guns placed in the most favorable position for rough weather?

The guns and turrets are in charge of line officers; that is the reason there was no "Court of Inquiry." The machinery in the engine room gave no trouble during the storm. If it had, rest assured there would have been a "Court of Inquiry," the majority of which court would have been line officers, and a general censure of those in charge of the engines would have been a foregone conclusion.

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Questions and Answers.

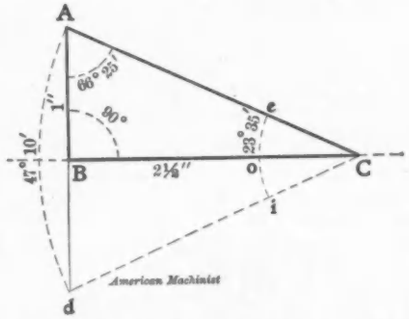
Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(189) C. E. K., Watertown, N. Y., asks: In a centrifugal pump with a fan 24 inches diameter, running at a certain speed, suction pipe and discharge pipe of a given length, with the vanes of the fan 3 inches wide at the hub and 1½ inches wide at the tip, or circumference; what will be the result under the same conditions if the vanes are made double the width, or 6 inches at hub and 3 inches at tip? Will the pump deliver twice the amount of water and use more power, or will the quantity of water remain the same, regardless of the width of the blades? A.—This is a question which it is obviously impossible to answer. It seems to assume, although it actually does not, that no change is to be made in any particular except in the width of the blades. With the change in the width of blades there should necessarily be a change in the case in which they revolve. Nothing is said either about the diameters of the pipes, and the existing diameters may be only sufficient for the orginal narrow blades. We may say, in a general way, that the wider blades will require more power to drive them, and that they will deliver more water, but we cannot attempt to say how much. If the pipes are enlarged to secure the same velocity of movement of the water through them, the pump will deliver about twice the quantity of water, and will require about twice the power to drive it.

(190) F. S., Jersey City, N. J., asks for information about port areas and valve travels for single-valve, high-speed shaft-governor engines. A.—One of the best builders of engines of this class makes the area of the passage 10 per cent. of the piston area in all cases. The extreme port opening with the governor balls down is made equal to the width of the port, and the point of cut-off with the governor in the same position is at three-quarters stroke. With shorter cut-offs the port is opened by a reduced amount, of course; but this is largely made up in this engine by a double port opening through the valve, which doubles the area at the reduced travel due to early cut-offs. To get the same openings at early cut-off with a valve giving a single opening only, would require over-travel at late cut-off to an amount which it would probably be difficult to secure. You need not be afraid of some reduction in the opening, however, as it has not as

important an effect as is usually supposed. Some good builders habitually give 25 or 30 per cent. less opening than the above. The area of the passage has more influence on the free movement of the steam than the area of the opening. There is a great tendency, in laying out piston valves, to give passages which are small in places. The dimension of the passage across it and perpendicular to the center line of the valve is often made so small as to give no adequate passage for the steam which passes the port on the side farthest from the cylinder. Your valve, being of the piston type, will make it easier to secure an adequate port opening with a given travel than would a pressure plate valve. This opening, to be effective, will, however, require that the passages are well laid out.

(191) C. C. S., Cincinnati, O., asks: 1. How much of a blow is a blacksmith's helper capable of striking with an 18-pound sledge? A.—The force of a blow cannot be properly stated in the manner suggested. Perhaps the best way to treat the matter will be to make the case more definite. Say that the sledge is raised and descends at each blow four feet, and that it strikes upon hot iron, making an indentation one-tenth of an inch deep, or that the descent of the sledge is entirely arrested in the space of one-tenth of an inch. We may first compute the velocity and force of the descent of the sledge, supposing it to be acted upon by gravity alone. The formula for the velocity is: $v = \sqrt{2 \times a \times s}$, in which v is the velocity in feet per second after falling the given distance, a the acceleration due to gravity, say 32 feet per second, and s the hight, or the vertical distance traversed in the fall. Substituting our values, we have: $v = \sqrt{2 \times 32 \times 4} = 16$ feet per second. The formula for the energy acquired is $E = \frac{W \times v^2}{64.4}$, E being the stored-up energy in foot-pounds, W the weight in pounds, and v the acquired velocity. Substituting our values, we have: $E = \frac{18 \times 16^2}{64.4} = 71.55$ foot-pounds. The force contributed by the helper cannot very well be determined. If we assume that the man was able to exert a force upon the descending sledge equal to that of gravity, then the total energy would be $71.55 \times 2 = 143.1$ foot-pounds, and as the descent was arrested in the space of .1 inch, the average resistance by which the sledge was stopped, or the average force of the blow, was $143.1 \div .1 = 1{,}431$ pounds. If the sledge had been stopped in the space of a hundredth of an inch, instead of a tenth, then the average force for the same blow would have been 14,310 pounds, so that the distance in which the stoppage is effected is quite as important a factor as the distance through which the force is applied. 2. What is the rating of a steam hammer with a cylinder 6 inches diameter and steam at 60 pounds pressure? A.—There is no customary "rating" for steam hammers; they are usually designated by the weight of the ram or "tup" plus the steam pressure, if any; but sometimes, very irrelevantly, by the total weight of the hammer apparatus. 3. Given a right-angled triangle with base 2½ inches and height 1 inch, how many degrees are there in each of the other two angles, and how are they found. A.—Let $A\ B\ C$ be the triangle. To ascertain the angle $A\ C\ B$, assume that $B\ C$ is the radius of a circle, $A\ B$ one half of the chord of an arc $A\ d$ of that circle. As $A\ B$ is 1 inch, $A\ d$ is 2 inches; and as $B\ C$ is 2½ inches, $2\frac{1}{2} : 2 : : 1 : .8$; then from a table of chords we find that the angle for a chord of .8, where the radius is 1, is 47°10′, and one-half the angle, or the angle $A\ C\ B$, is therefore 23° 35′. As the sum of the three angles of a triangle is 180 degrees, and as one of the angles in this case is 90 degrees, we have 90 degrees left for the sum of the other two angles, and 90° — 23° 35′ =



66° 25′, which is the angle $B\ A\ C$. 4. Will you give me a few pointers on how steel is made.? A.—This would be too big a job for us to undertake. For general information on the subject, consult any good encyclopedia; and for more specific information read books which describe steel-making processes.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 14.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

"Blue Prints, Modern Steam Engine Design." Part one and two now ready. Each part 30 cents. Theo. F. Sheffler, 943 E. 21st Street, Erie, Pa.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

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Literary Notes.

TABLES FOR IRON ANALYSIS. By John A. Allen. 85 5½ x 9-inch pages. John Wiley & Sons.

These tables are intended to facilitate the work of the chemist engaged in iron or steel analysis, by giving, without calculation, the percentage of a given element entering into a substance, from the weight of a definite compound of that element, found in analyzing a grain of the substance. The book should prove of decided utility to specialists in this line of work. Price not stated.

THE BICYCLE—ITS CARE AND REPAIR. By C. Von Curlin.

This is a small pamphlet telling how to make ordinary repairs to bicycles, and also to some extent how to avoid the necessity for repairs. It is illustrated and is a useful little book. Paper cover. Published by the Frasse Company, 19 Warren street, New York. 25 cents.

The National Ball Nozzle Company is being sued, at Trenton, N. J., by the Columbia Hose Nozzle and the American Nozzle companies, for an infringement of patent. The defendant answers that the essential and substantial features on which the patents are based were known, among others, to "One Herod, now deceased, but formerly of Alexandria, Egypt, living at said Alexandria and elsewhere, 1000 B. C."

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Mr. William A. Harris, the manufacturer of the Harris-Corliss engine, died at the residence of his son, Mr. Fred Harris, Providence, R. I., on the 29th inst., in the sixty-second year of his age.

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Commercial Review.

NEW YORK, FRIDAY, OCT. 30TH.

DYNAMOS AND MOTORS.

When this article reaches the eyes of its readers, we shall be living in such a new era that anything which has gone before the election may seem like ancient history; but, nevertheless, it is well to consider the condition in which the electrical business enters its new surroundings.

That condition, all things considered, is a fairly satisfactory one. Although the actual business transacted is not uniformly good, and in the electrical, as in other branches of trade, many orders are hanging fire until after election, the undertone of the market shows strength, influenced in some cases by actual demand, but due more especially to bright expectations. This is certainly true in respect to electrical machinery for street railway purposes. While the dull times could not entirely check the demand from that source, they were very effective in preventing the installation of new roads. The indications are that, when the flood-gates of business are opened, a good deal of electric railway demand will come sailing along with it. We hear that five large new enterprises of this character, four of them in or near this State, are expected to materialize into contracts if the results of the election are such as to give satisfaction to business men; but we do not, of course, intend to give this as a complete list of the new work in prospect.

Lighting dynamos for isolated plants to be used in local office buildings, etc., show an improved tone. It is the season for them, and perhaps the fact that buildings such as require them were begun some time ago, and are now in a state of construction beyond abandonment, may also be an effective cause. On the other hand, motors for factory power purposes are not, at present, attracting especial attention, although it cannot, perhaps, be said that the tone of this branch of the market has actually weakened. The remark is made that orders were taken in some time ago which have rather swept the deck.

EUROPEAN DEMAND FOR AMERICAN MACHINE TOOLS.

We are able to present this week some opinions from two more of the manufacturers who have been abroad in the interest of American machinery. One of these was Mr. Murray Shipley, Jr., of the Lodge & Shipley Machine Tool Company, Cincinnati. He says that the factory is busy, and that this is principally owing to foreign orders. In regard to trade with France, he believes that there is considerable potential demand from that country, but that some educational work must be done there in order to render this demand an actual one. Further, he reiterates the idea to which emphatic utterance is frequently given, that personal effort is necessary in obtaining orders. The attempt to do foreign business solely by catalog he considers futile.

Mr. C. A. Clarke, of Hill, Clarke & Co., Boston, writes us a letter containing some timely words of caution as to this export subject:

"Just at present we find the export demand for American machine tools very large. This is owing, first, to the great business activity in England and all over Europe. Secondly, on account of this great business activity, the manufacturers of machine tools, in Europe, are not able to name satisfactory deliveries to their customers. Although we have always had a large amount of foreign trade, on account of the superiority of our machine tools, this trade is now increasing to large proportions by what we call 'over-flow' orders. We see signs, however, that this business is going to fall off very materially inside of the next twelve months. The European manufacturers of machine tools are increasing their capacities very rapidly, and other manufacturers are also increasing so much that we doubt if there will be an outlet for their product.

"The conditions in Europe are very much as they were in this country the last of '81 and first of '82, and you will very likely recall that business took a great slump here in July of '83. There is a speculative feature about a great deal of the increase in business abroad, owing to the anxiety of capitalists to get a larger percentage for their investments, and this condition usually indicates the top of the boom."

The export trade in iron-working machinery, just now, is a free horse, and there is some danger that it will be driven to death as the home bicycle business has been within a year past. There is a startling parallelism between these two aggressive movements which, during successive years, have served to bridge over the chasms of the market. However, the export business, from its very nature, is not liable to the sudden collapse which the bicycle boom suffered, and we expect with much confidence that, if it subsides,

(Continued on page 37.)

Just Published. Two Reliable Books.

"SHOP KINKS,"

By ROBERT GRIMSHAW. Showing special Ways of Doing Work Better, more Cheaply, or more Rapidly than Usual.

400 Pages, 225 Illustrations, $2.50.

"THE MODERN MACHINIST," By JOHN T. USHER, Machinist.

320 Pages, 257 Illustrations, $2.50.

Illustrated circulars of both sent free.

NEARLY READY.

"GAS, GASOLINE AND OIL ENGINES,"

By GARDINER D. HISCOX, M. E.

400 Pages. 200 Illustrations. Price, $2.50.

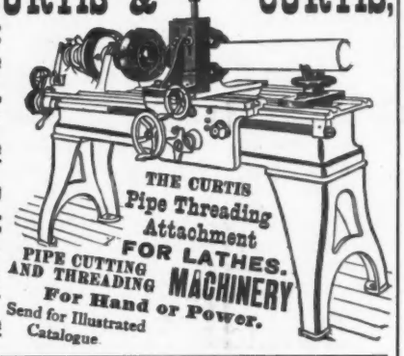
This book treats comprehensively, and almost entirely of American makes of Gas, Gasoline and Oil Engines, with instructions for the care and management of the same.

Our Catalogues of Books for Machinists, Engineers, Electricians, etc., also sent free.

NORMAN W. HENLEY & CO., Publishers,
15 Beekman Street, NEW YORK.

CURTIS & CURTIS,

66 Garden St., Bridgeport, Ct.



THE CURTIS Pipe Threading Attachment FOR LATHES. PIPE CUTTING AND THREADING MACHINERY For Hand or Power.

Send for Illustrated Catalogue.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD, CONN.

J. M. ALLEN, President.
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F. B. ALLEN, Second Vice-President.
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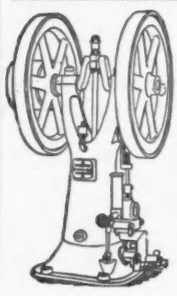


This beats Wind, Steam or Horse Power.

We offer the

WEBSTER 2 1-2 ACTUAL HORSEPOWER

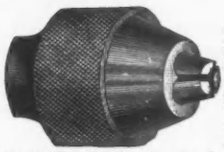
GAS ENGINE

For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.

Write for Special Catalog.

WEBSTER MFG. CO.
1079 W. 15th St., CHICAGO.

A Twenty Years' Record!



THIS CHUCK has been continuously advertised in the **American Machinist** since the first issue of the paper.

In spite of imitations the largest number of sales of the Almond Drill Chuck were made during the year 1895.

T. R. ALMOND,
83 Washington Street, Brooklyn, N. Y.

Electrically Driven Machinery

For Machine Shops, Engine Works, Tool Works, and all other Manufacturing Establishments.

We are the largest builders of

Electrical Apparatus

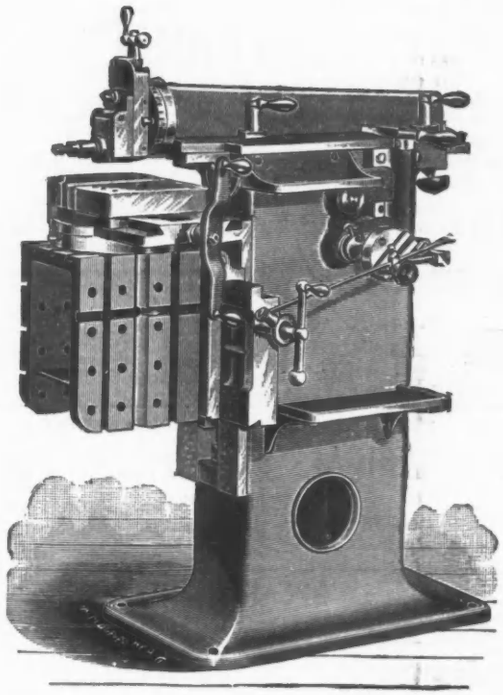
in the World, and we can satisfy you of the ECONOMY of Electric Drive

In Time, Labor and Space, and Prove It in Practice.

State your case and we will prescribe.

General Electric Co.
Schenectady, N. Y.

Sales Offices in all large cities in the U. S.



Improved 15" Hendey Shaper.

Latest Improvements.
Useful : Attachments.
Strong and Powerful.

For Die Work, Tool Room or General Shop Work.

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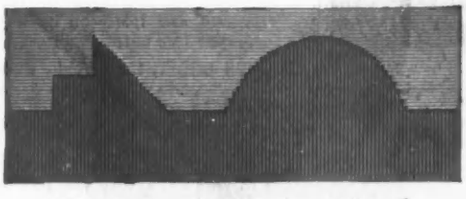
The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work, table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how stroke can be adjusted with machine in motion by micrometer, adjustment fine and delicate. Send for circular.

The Hendey Machine Co.

Torrington, Conn.

Agents for the Pacific Coast—Pacific Tool & Supply Co., San Francisco, Cal.

European Agents, { Chas. Churchill & Co., London and Birmingham.
Schuchardt & Schutte, Berlin and Vienna.
Eugen Soller, Basel, Switzerland.

(*Continued from page 36.*)

plenty of domestic trade will be coming on to take its place.

SEPTEMBER MANUFACTURING EXPORTS.

From the following table may be seen the remarkably good total made by September in manufacturing exports of all classes. In addition to the comparisons given, it may be said that it exceeded that of July or August of this year, although not a month in which very heavy exports of manufactured goods are to be expected.

Year.	Manufacturing Exports. September.	Nine Mths.	Total Exps. Nine Mths.
1890	$14 011,947	$113,899,554	$563,468,545
1891.....	13,180,090	126,754,421	627,670,414
1892.....	12,162,076	111,287,911	653,836,630
1893.....	16,382,431	129,998,845	587,040,111
1894. ...	15,322,848	133,292,880	562,278,557
1895. ..	16,352,356	145,793,834	546,424,359
1896.....	21 684,784	184,792,443	650,956,354

IRON AND OTHER METALS.

Notwithstanding the close proximity of election, leading pig iron firms in this city report quite a heavy business. Southern irons have been advanced 25 cents. The export movement of the spring, summer and fall of this year has carried some 50,000 tons of American pig iron abroad. Great Britain has been the principal purchaser, and some has gone to Genoa. Export sales for the past few weeks have been about 4,000 or 5,000 tons per week. In answer to complaints of home consumers as to unfair treatment in regard to prices, it is said that the foreign sales net the Birmingham, Ala., furnaces more money than those for domestic account.

Present metal quotations may be revolutionized after next Tuesday. Lead is now strong, and spelter is notably so.

Quotations.

NEW YORK, Friday Evening, October 30th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 75 @ $13 00
No. 2 foundry, Northern	11 25 @ 12 00
No. 2 plain, Northern	10 50 @ 11 00
Gray Forge	10 50 @ 10 75
No. 1 foundry, Southern	11 75 @ 12 00
No. 2 foundry, Southern	11 25 @ 11 50
No. 3 foundry, Southern	10 75 @ 11 00
No. 1 soft, Southern	11 25 @ 11 50
No. 2 soft, Southern	11 00 @ 11 25
Foundry forge, or No. 4 Southern	10 50 @ 10 75

Bar Iron—Base—Mill price, in Carloads, on dock; common, 1.10 @ 1.15c.; refined, 1.20 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5 @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, 1.65 @ 1.70c. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 10¾ @ 10⅞c.; electrolytic, 10⅝c.; casting copper, 10⅜ @ 10½c.

Pig Tin—For 5 and 10-ton lots, 13.10 @ 13.20c., f. o. b.

Pig Lead—In carload lots, 2.87½ @ 2.90c., f. o. b.

Spelter—In carload lots, New York delivery, 3.90 @ 4.00c., f. o. b.

Antimony—Cookson's, 7.25c.; Hallett's, 6.45c Japanese, 6.35 @ 6.45c.

Lard Oil—Prime city, present make, commercial quality, in carload lots, 43 @ 44c.

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Manufactures.

A new water-works will be built at Emsworth, Pa.

The Steelton Flouring Mill Co., Harrisburg, Pa., will place new machinery in their plant.

The Geiser Mfg. Co., Waynesboro, Pa., will install new machinery in their pattern department.

Mr. J. Norwood has decided to place an electric light plant in the village of Alvinston, Ont., Canada.

P. F. Olds & Son, Lansing, Mich., manufacturers of

gas and gasoline engines, will increase the capacity of their plant.

The Excelsior Mfg. Co., Erie, Pa., will install new machinery for manufacturing tools, motors, engines, bicycles, etc.

The Winfield Mineral Company, Pittsburgh, Pa., will install 100-horse power engines and boilers at its plant at Winfield, Pa.

A large new foundry will be built by the American Brass Manufacturing Co., of St. Louis, Mo. New machinery will also be installed.

The Iron City Brewing Co., of Pittsburgh, Pa., are making extensive additions to their plant. New pumps, engines, etc., will be installed.

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Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Compt. draftsman wants pos. E. P., AM. MACH.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Wanted—Position by foreman boiler maker. A hustler. Best references. BOX 135, AM MACH.

A young mechanical engineer, graduate, wants position. BOX 127, care AMERICAN MACHINIST.

Competent draftsman wants position; interior town or West preferred. BOX 128. AM. MACHINIST.

Wanted—A first-class die and tool maker wants position in charge; best of reference. BOX 123, AMERICAN MACHINIST.

Tool maker, machinist, strictly temperate, exp. in modern methods of tool making and gig work, wants position. BOX 134, AMERICAN MACHINIST.

Wanted—Position as foreman of machine shop by man of experience and ability; can furnish best of references. Address BOX 122, AM. MACHINIST.

Position wanted by an experienced tool maker; 20 years in gun, sewing machine and bicycle shops; can handle help. BOX 132. AMERICAN MACHINIST.

Wanted—Position as brass f'ndry foreman; has had 18 years' experience in the foundry business, capable and energetic. BOX 129, AMER. MACHINIST.

A first-class mechanic desires a permanent situation with engine firm; experience on tools, vise and erecting; temperate; energetic. BOX 126. AM. MACH.

Wanted—Foreman for machine shop; medium weight machinery and jobbing; state experience and expectations. BOX 120. AMERICAN MACHINIST.

Mach'st, also dftsmn., with elect. knowledge, desires pos. in mach. or elect. factory; German; speaks little English. G. W., 1026 Lawrence st., Phila., Pa.

Mechanical draftsman, experienced in shop and drawing room, general and power transmitting machinery, wants position. Add. BOX 117, AM. MACH.

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(*Continued on page 39.*)

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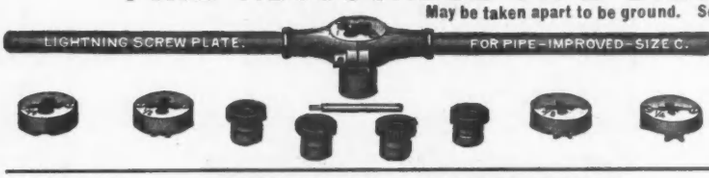

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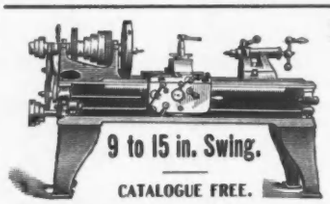

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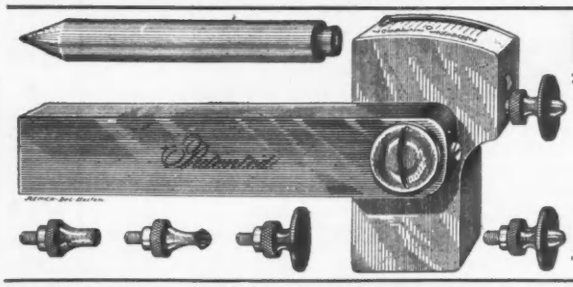

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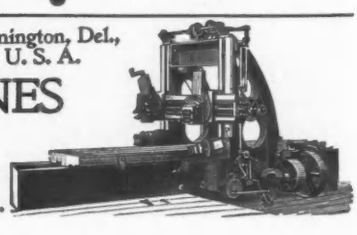
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